VOL. XXXII. — No. 7.

JULY 1955.

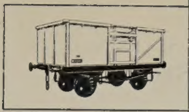
Monthly Bulletin of the International Railway Congress Association

(English Edition)

CONTENTS

OF THE

32nd YEAR OF THE ENGLISH EDITION.



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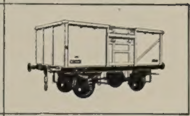

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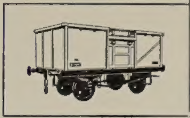

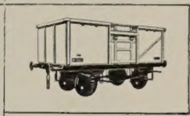

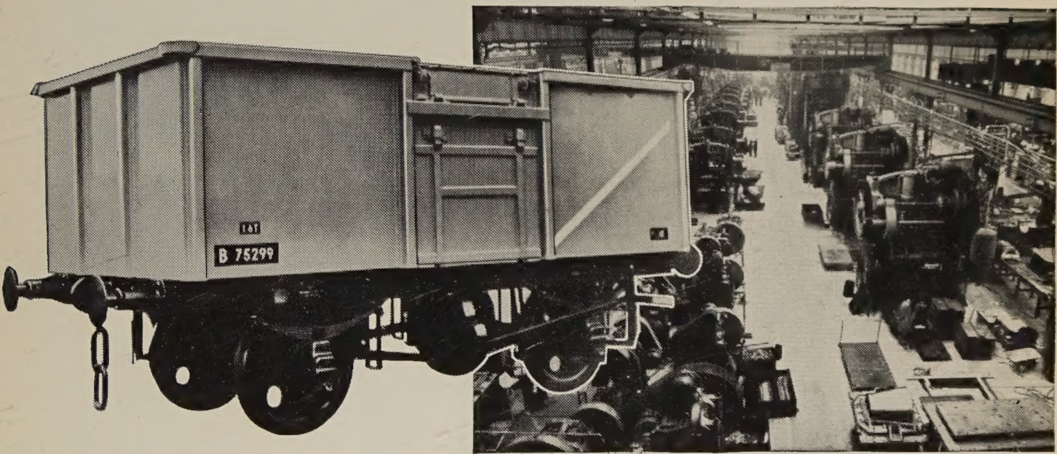

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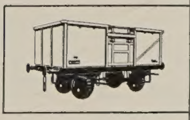

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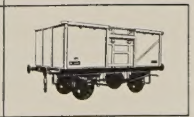

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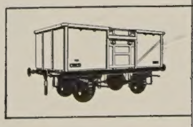

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Bulletin of the International Railway Congress Association

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MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

PUBLISHING and EDITORIAL OFFICES : 19, RUE DU BEAU-SITE, BRUSSELS

Yearly subscription for 1955 :	**Belgium**	**700 Belgian Francs**
	Universal Postal Union . .	**800 Belgian Francs**

Price of this single copy : 80 Belgian Francs (not including postage).

Subscriptions and orders for single copies (January 1931 and later editions) to be addressed to the General Secretary, International Railway Congress Association, 19, rue du Beau-Site, Brussels (Belgium).

Orders for copies previous to January 1931 should be addressed to Messrs. Weissenbruch & Co. Ltd., Printers, 49, rue du Poinçon, Brussels.

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An edition in French is also published.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

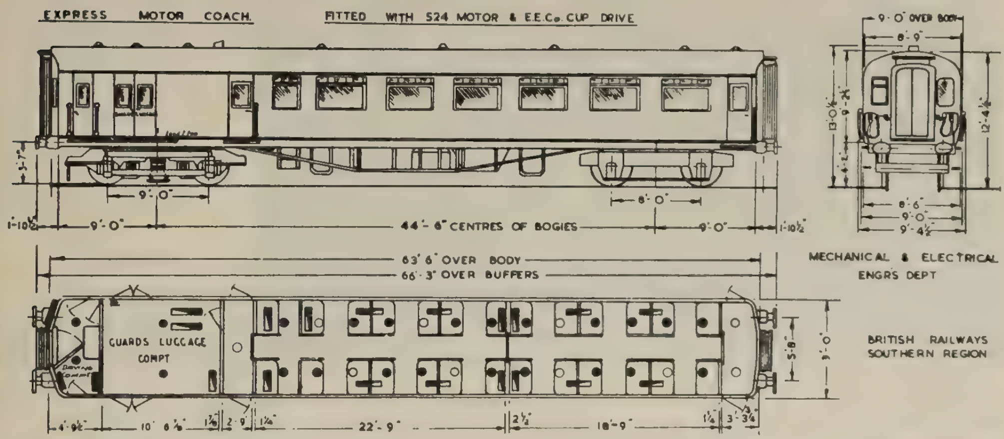
[621 .337]

Individual axle drive.

Mechanical systems used on electric locomotives and motor coaches, with an indication of the results obtained in service on railways of all kinds,

(Continued)*

by Adolphe-M. HUG,
Consulting Engineer, Thalwil (Zurich), Switzerland.



Plan BR-SR

Fig. 486. — Express motor coach, British Railways, Southern Region, fitted with flexibly suspended motors and quill cup drive as in figs. 480-485 (see also fig. 487).

An exactly similar motor coach is fitted with SLM spring and cup mechanism, as mentioned in Chapter V.

N.B. — It will be seen that only the left-hand bogie is driving, the other being a carrying bogie. The series number for this coach had not been determined in May 1953; the number mentioned on the page following fig. 485, No. 3059, is the class number of the set, each set being composed on two motor coaches of the same type. The black and white rectangles in the lower plan show the heaters; the white circles are lamps supplied for the complete set, the black circles are lamps supplied for the motor coach.

Metric dimensions :

driving bogie wheelbase, mm	2 743	length of body, m	19.36
carrying bogie wheelbase, mm	2 438	max. width of body, m	2.86
distance between bogie pivots, m	13.58	height of roof, m	2.97

(*) See *International Railway Congress Bulletin*, for February 1953, p. 65; May 1953, p. 245 and November 1954, p. 1069.

Figure 487 shows a driving bogie of the sets comprising two motor coaches, each having one driving and one carrying bogie, the sets being designated « Express Unit 3059 » and designed to work on the line between London and Portmouth. Fig. 487 aptly supplements figures 481 to 484 since it shows the motors, in the bogie frame, fitted on the axles.

— 201 $2B_0B_02$ locomotives, class E.428, single body, built by the Breda Ansaldo, Marelli and Brown Boveri (TIBB) Companies;
— 14 electric motor coach units, series 200, built by Breda;
— 103 motor coaches, classes ALe 790, ALe 880 (these two series are mentioned on p. 253 of *Vol. II*)

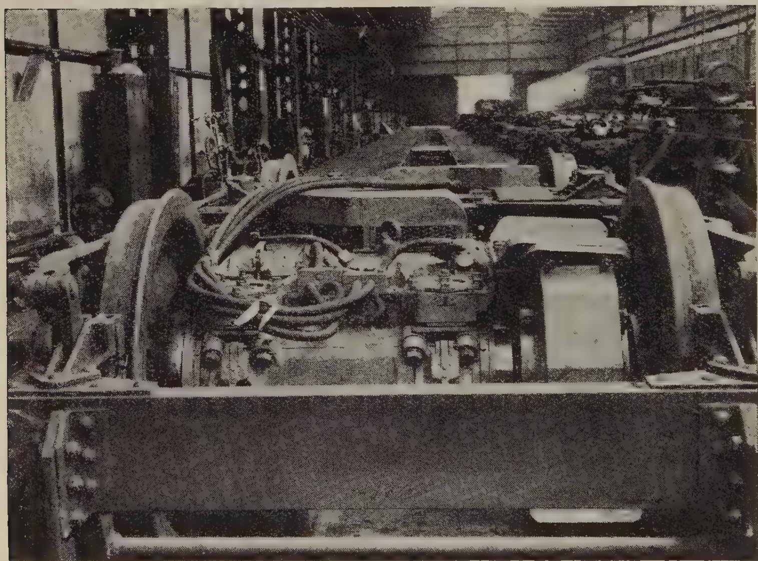


Fig. 487. — Driving bogie of motor coach in fig. 486; front view taken in workshop. Cf. fig. 483, top of fig. 484 and top, left, corner of fig. 485.

Photo British Railways n° 1630/51.

and ALe 400, built by the Breda, Ansaldo, Marelli, Savigliano and CGE Companies. The first two of these series are the normal 3rd class type, the third one is a de luxe type with kitchen.

Following the notes on the page containing figure 480, concerning the *Italian State Railways, (F.S.)* we may mention the number of locomotives or motor coaches fitted with *Bianchi*, *Negri I* and *Negri II* mechanisms :

Bianchi (354) transmission :

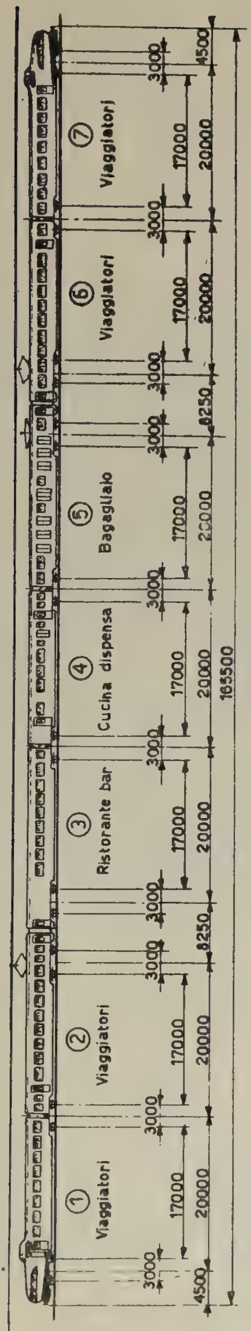
— 12 $2C_02$ locomotives, class E. 326, built by the Breda Works;

Negri I (355) mechanism :

— 39 $2B_0B_02$ locomotives, class E. 428, built by Ansaldo and TIBB;

(354) See *Vol. I*, pp. 67-69 (fig. 140-142), and *Vol. II*, pp. 91-92 (fig. 113), 157 (fig. 199), 245-246 (fig. 305-307) and for motor coaches, pp. 93, 250 and 161-163 (fig. 114 and 313-318). — *Congress Bulletin*, April 1948, November 1949, etc.

(355) See *Vol. II*, pp. 156-158 (fig. 200-201) and 245-250 (fig. 308-312).



Plan BREDA.

Fig. 488. — Dimensioned sketch of Italian State Railways 7 coach high speed articulated de luxe electric motor set, ETR 300 (3 000 V D.C.). The four articulating bogies are carriers, the other six are drivers.

Coaches 1, 2, 6 and 7 are saloons, with « observation » coaches at the ends, the driver's look-out position being above the roof. Coach 3 is the restaurant-bar, coach 4 the kitchen and service accommodation, coach 5 being luggage and train staff.

— 118 $B_0B_0B_0$ articulated locomotives, with two-part bodies, class 626, built by Breda, Ansaldo, Marelli, TIBB, Savigliano and CGE;

— 158 B_0B_0 locomotives, class 424 (figs 312 and 479), same builders as the previous 118 (already mentioned on the page with figs 478-479).

Negri II (356) mechanism :

— 4 express electric motor coach sets, series 200, built by Breda (357),

— 40 motor coaches ALe 883, built by the Breda and Marelli Companies.

With regard to the two high speed, de luxe, electric sets ETR 300, comprising 7 coaches (see figs 488 and 492) (358), we will here mention only the flexible drive; this is a mechanism (developed by the engineer Fanelli, of the FS) which was mentioned on the page following

---

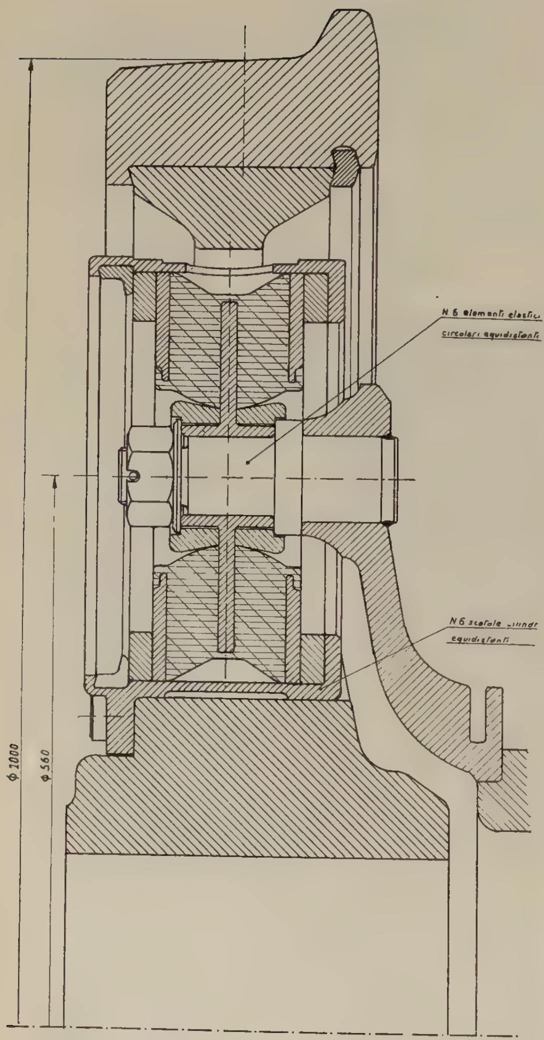
(356) See *Vol. II*, pp. 160-163 (fig. 202-203 and 211-212) *Congress Bulletin*, October 1948.

(357) If we are not mistaken, these are fixed sets (trains-blocs) composed of two driving coaches and one trailer between, with pneumatic doors.

(358) See *Ingegneria Ferroviaria*, Rome, No. 7/8, 1953, « L'elettrotreno F.S. series ETR 300 », pp. 515-586, 130 figs. and diagrams, 7 plates and drawings, A. CUTTICA, A. D'ARBELA, G. MINOLETTI, F.S. OREFICE, R.VERZILLO, M. FANELLI, M. MARTINELLI, M. FASOLI, F. BIANCHI, S. BUONI.

Also, *E.T.T.*, No. 7-9, 1953, « Die elektrischen Gelenkschnelltriebzüge, Reihe ETR 300, der italienischen Staatsbahnen », pp. 84-86, 6 figures, Ad.-M. HUG. — *R.G.C.F.*, January 1954, « Les rames motrices électriques de luxe à grande vitesse des Chemins de fer italiens de l'Etat », 6 pages, 8 figures (photos and drawings), Ad.-M. HUG. — *V. & T.*, No. 9, September 1953, « Neuer Scnhelltriebwagenzug in Italien », pp. 301-302, 1 figure, 2 tables, E. CRAMER.

figure 449 and the pages containing figures 450 and 451. The principle is described in the left-hand column of the page with figure 451 ([359]) and the arrangement is shown in figures 489 and 490. We will refer to this mechanism as the « Fanelli », who designed it in collaboration with SAGA, Milan.

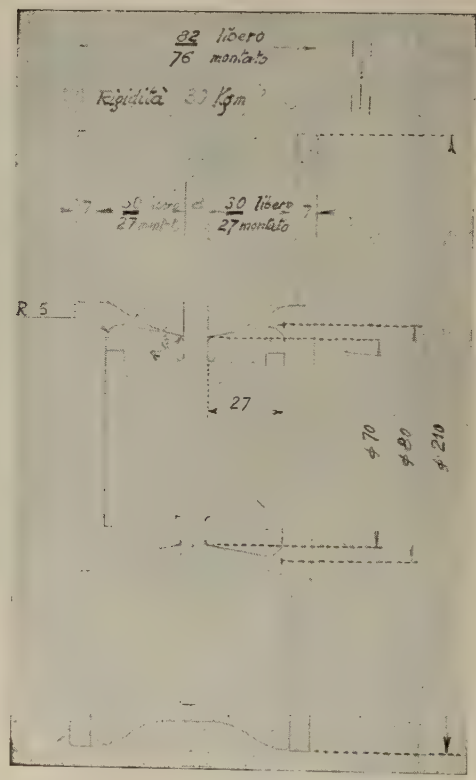


Plan SAGA (Pirelli). n° 3266.

Fig. 489. — Arrangement of FS « Fanelli » flexible drive for sets in fig. 488.

The upper note (in Italian) indicates the pivot of one of the six rubber units, symmetrically arranged round the wheel centre (cf. fig. 446-449).

The lower note indicates one of the six sleeves enclosing the six rubber units.



Plan SAGA (Pirelli) n° 2989.

Fig. 490. — One of the separate rubber units shown in the centre of fig. 489. Max. compression of coach unit = 1 700 kg corresponding max. deflection = 8 mm.

N.B. — The dimensions not underlined « montato » indicate the fitting condition (precompression).

([359]) *Congress Bulletin*, May 1953, p. 266.

The two « elettrotreni » sets ETR 301 and 302, built by the Breda Works, were put into service between Milan and Naples on the 30th March 1953. They are also designated MN sets (Milan-Naples) (see fig. 492).

With regard to the driving units of various *Swiss* systems, fitted with *Secheron I* mechanism, mentioned after the table of Austrian locomotives (between figs 464 and 465) the information can be supplemented by the following details regarding the builders :

— the two locomotives under *d)*, BLS, $1C_0$-C_01, Nos. 207 and 208 (class Ae 6/8) were built by SLM-Winterthur for the mechanical part, the electrical equipment being provided by the Secheron Works, Geneva;

— the motor coach under *e*) of the BT Railway, No. 44, was built by the SIG-Neuhausen Co. for the mechanical part, and Secheron, SAAS, for the electrical equipment;

— the B_0B_0 locomotives under *f)* of the EBT Railway, Nos. 109 and 110, put into service, No. 109 in 1944 and 110 in 1953, were built by SLM-Winterthur for the mechanical part and the SAAS, BBC (Brown Boveri) and MFO (Oerlikon) Companies for the electrical equipment.

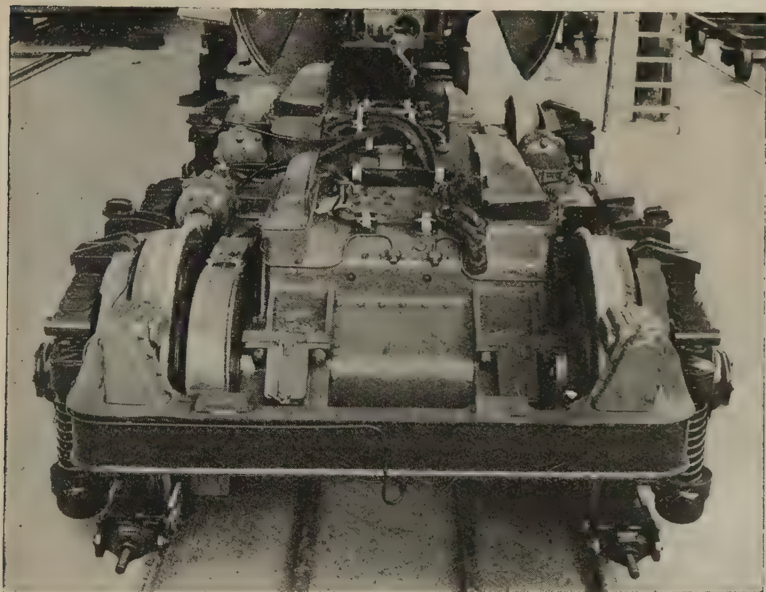


Fig. 491. — Front view of one of the driving bogies of the set in fig. 488. Unilateral gears. Against the wheel centres (inside) can be seen the discs forming the ends of the hollow shaft, each carrying the six resilient transmission units of fig. 490.

Above the bogie is an interior body-end with « Scharfenberg » drawgear.

Photo BREDA 2911/759.

With regard to the Swiss Federal motor brake vans, series 801, class Fe $^4/_4$ in figure 444 and adjacent table ([360]), Nos. 801-809 and 817-824 (17 motor coaches) were built, mechanical part, by the « Fabrique Suisse de Wagons et

([360]) *Congress Bulletin*, May 1953, pp. 259-260.

d'Ascenseurs, S.A. » of Schlieren-Zurich (SWS), who in 1949 equipped the two cars Nos. 803 and 819 with new bogies having Secheron leaf-spring drive (see legend to fig. 444). The other motor brake vans of this class, Nos. 810 to 816 and 831, were built by the Swiss SIG of Neuhausen near Schaffhouse, who had previously also built the four Swiss Federal motor coaches, class $Ce^4/_6$, Nos. 759-762 (former numbering 9809-9812) with nose-suspended motors.

Still dealing with Switzerland, we may note in the list of applications on the page with figure 461 (and the following page) under *a*) to *d*) dealing with the *Brown Boveri spring mechanism* (see page with fig. 456) [361], we did not include the fitting of this mechanism to the $CFe^4/_4$ motor coach No. 62 of the Swiss South Eastern Railway, Südostbahn SOB. This system connects Waedenswil (on Lake Zurich) with Arth-Goldau (on the Bale-St-Gothard line) with branches to Einsiedeln (Schwyz Canton) and Rapperswil (St. Gall Canton) where it again rejoins the CFF and also the BT (Bodensee-Toggenburg).

Fig. 492. — View of one of the ultra rapid, de luxe electric motor coach sets of 7 coaches, ETR 300, FS (see fig. 488 and 491), 3 kV, D.C. on trial in 1952 on the « direttissima » line, Bologna-Florence.

Photo BREDA 3013/763.

The SOB system has not previously been mentioned in this work as, so far, all motor coaches have been equipped with nose-suspended motors.

Figures 493 and 494 respectively show the $CFe^4/_4$ motor coach No. 62 (built by the « Fabrique Suisse de Wagons et d'Ascenseurs », Schlieren-Zurich SWS)

(361) *Congress Bulletin*, May 1953, pp. 271-276.

and one of the driving bogies, in which can be seen the casing of the gear and unilateral transmission with hollow stub axle.

With regard to the Swiss Federal Railways and figures 118 and 119 of *Vol. II*, pages 134-137 and 140-141, it can be mentioned that the axle fitted in 1935 with the Meyfarth *(Secheron II)* mechanism on the 1-C_0-1 class $Ae^3/_5$, No.10204 (fig. 118), has subsequently been fitted to a 2-C_0-1 locomotive, class $Ae^3/_6$, series No. 10270. Trials were undertaken in 1951 with this axle, replacing the knucklepins by rubber pads. This trial has so far given good results and it is hoped to provide a diagram showing the general arrangement. The Swiss Federal Railways intend to convert similarly several other locomotives of the same type, at present fitted with the Westinghouse spring drive (see figs 72 to 78 of *Vol. I* and 34-36 of *Vol. II*).

Photo Oerlikon P. 52666.

Fig. 493. — Motor coach No. 62, class CFe 4/4 Swiss SOB at Samstagern station (standard gauge, grades up to $50^{o}/_{oo}$, single phase, 15 kV, 16 2/3 cycles).

BUILDERS :

Complete mechanical parts : SWS-Schlieren — Traction motors : Sécheron. — Electrical equipment : MFO (Oerlikon). Transmission : BBC springs.

As this chapter IV dealing with spring or rubber mounted transmissions cannot be indefinitely prolonged, we will conclude by describing a tramway type bogie of a new type with rubber transmission developed in Germany by DÜWAG, Dusseldorf. The first prototypes have

been in service since 1933-1940 (two about 1933 and twenty more about 1940) and have been described in the technical press ([362]).

This bogie is characterised by the use of a single motor arranged longitudinally and wholly suspended, the two ends of the armature shaft each driving one axle by means of angular gearing with rubber-mounted coupling. This is therefore not strictly an individual axle drive, but we have already covered many cases where, either because of the construction or for operating reasons, it has been found desirable to drive two axles by one motor or a group of motor, or even two twin motors driving one axle (see for example figs 23, 30, 45, 50-53, 96, 110, 126, 199-200, etc. of *Vol. II*). It is, however, a *flexible transmission* and we are therefore going to describe it.

Figures 495-498 clearly show the arrangement of the motor, connected to the two axles through rubber-mounted disc transmissions. Figure 495 shows in elevation and plan the motor group for two axles with the roller-bearing axle-boxes but without the bogie frame and pivot. The same group is shown in the photograph forming figure 496. Figure 497 shows the same group with the bogie frame in position, carrying the side bearing springs for the ring-cradle which runs on ball bearings. Figure 498 shows the bogie complete with the cradle supported by the side springs. Outside the latter

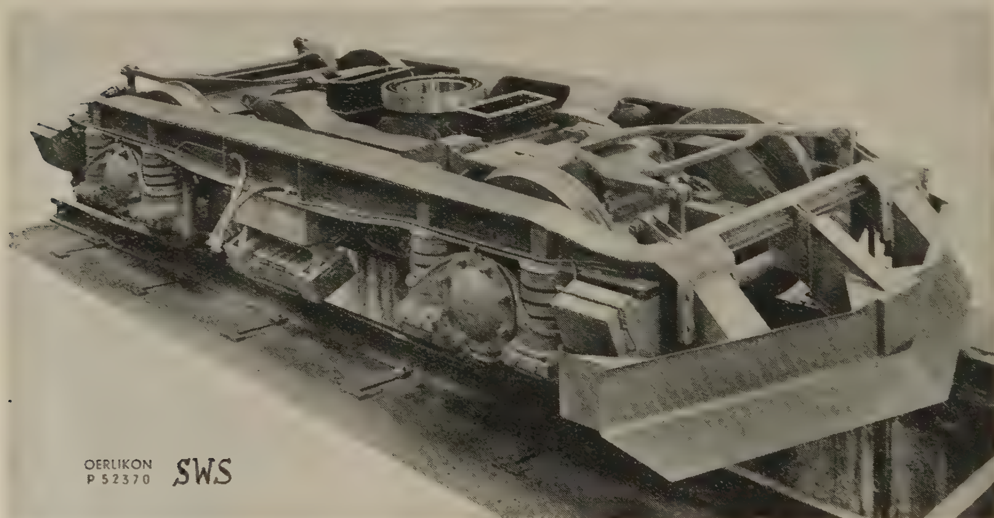
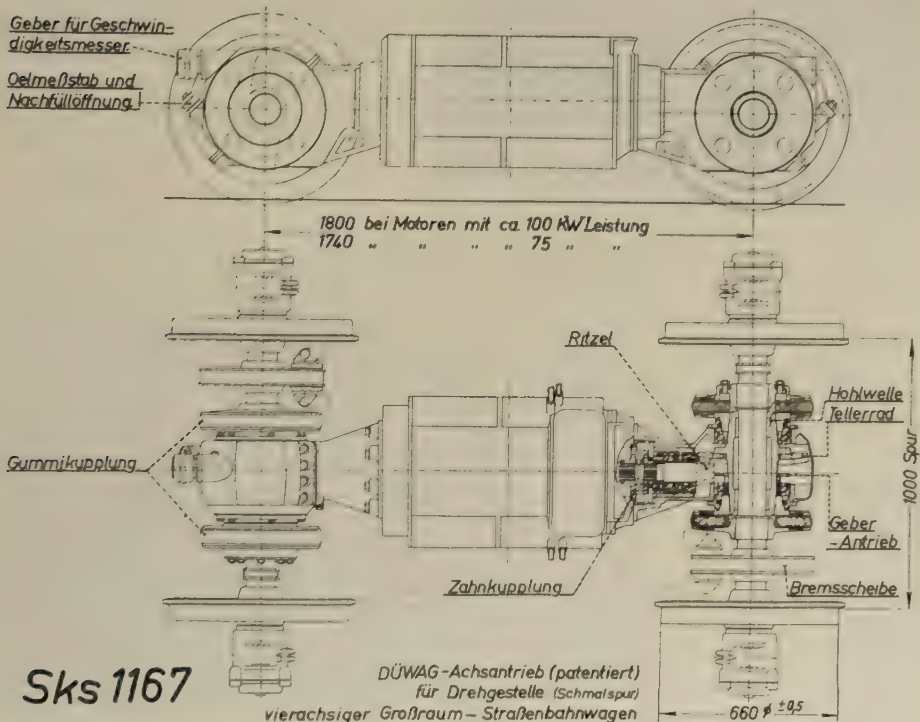


Fig. 494. — Driving bogies of motor coach in fig. 493.

([362]) See *E.T.T.* (formerly *L'Allègement dans les Transports*), Nos. 7-8 and 9-10, 1937 (pp. 83-88 and 135-139) with 8 figs. and 2 tables, « Motrices légères à grande capacité des tramways d'Essen » (bilingual) W. PRASSE.

and in the transverse centre line of the bogie are the shock absorbers. Finally, figure 499 shows a set which has been in service since the end of 1951 (having similar structural features but of course having no motor or transmission. Metre gauge, line voltage 600 V D.C., 250 H.P. per motor coach. Operating speed is



Plan DÜWAG « Düsseldorfer Waggonfabrik ».

Fig. 495. — Set of wheels with motor and transmission, in elevation and plan for one of the driving bogies of the motor coach in fig. 499, metre gauge, with DÜWAG suspended flexible transmission at the two ends of the armature. — This is a fairly new type of driving bogie for modern high-capacity tramway vehicles.

Translation of German terms :

Geber f. Geschw.-Messer = joint for speed indicator;
Oelmasstab und Nachfüllöffnung = oil measuring and filling hole;
Leistung = power;
Gummikupplung = rubber coupling;
Ritzel = pinion;
Zahnkupplung = geared coupling;
Hohlwelle = hollow shaft;
Tellerrad = dished gear wheel;
Geberantrieb = transmission;
Bremsscheibe = brake drum.

by the spring of 1953 already run more than 150 000 km) on the Dusseldorf « Rheinische Bahngesellschaft »; the motor coach, series 2001, is fitted with bogies, figure 498, the trailer having about 22 km (13.6 miles)/h, maximum speed 60 km (37 miles)/h.

Other applications have been made as follows :

— one motor coach No. 7000, on the

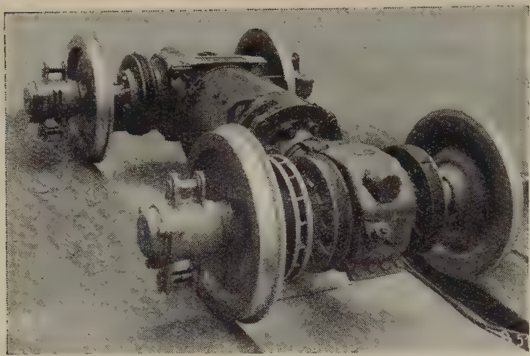


Fig. 496. — Set of wheels with suspended motor and flexible transmission, figs. 495 and 498 (driving bogie). This is the actual photograph of the set shown in fig. 495. As in fig. 497 the brake drum is clearly seen.

Photo DÜWAG B. 519.

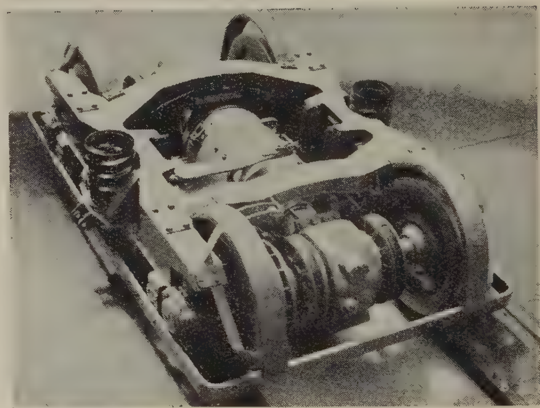


Fig. 497. — Same set of wheels as fig. 495 and 496, with bogie frame and coil side bearing springs fitted.

Photo DÜWAG B. 536.

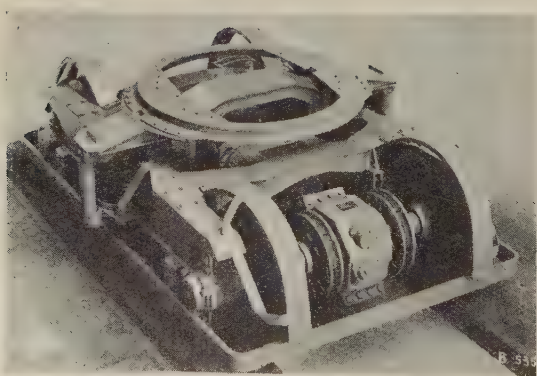


Fig. 498. — Driving bogie of figs. 497, 496, 495 and 499 with body pivot ring on the side bearing springs. The pivot ring on ball bearings forms the body cradle. The driving bogie is here complete. This photograph clearly shows the double discs with rubber insert carrying the whole motor transmission group.

Photo DÜWAG B. 535.

Berlin BVG, Transport system in service since December 1952;

— 14 motor coaches, Nos. 202-215, on the Bochum (Ruhr) Transport system, in service since May 1953;

— 2 motor coaches on the Ravensburg local railway (metre gauge, 750 V D.C., owned by the DB). These are numbered ET 195-01 and -02 and each have one driving and one carrying bogie.

495-498) which holds the conical gears. The possible compression of the rubber, however, allows a more important displacement. In the direction of the transmitted couple, with maximum braking, the displacement of the cover discs (vulcanised on the rubber) in relation to each other can be 1.5°, which corresponds to 4 mm (0.15 in.) in the central plane of the rubber segment. Here also, the

Fig. 499. — Tramway motor set, high capacity, series 2001, of the Düsseldorf « Rheinische Bahngesellschaft », metre gauge, 600 V D.C. A large system, which includes long interurban lines.

The set is composed of one motor coach and one trailer, each with 4 axles (two bogies, fig. 498). The carrying bogies of the trailer are of similar construction to those of the driving vehicle. Power per driving bogie — 125 H.P. or 250 H.P. per motor coach. Max. speed 60 km/h.

Cliché DÜWAG B. 412.

In addition, there were under construction in the spring of 1953 about 100 vehicles of the tramway type with the same type of bogie intended for the principal secondary services of the Ruhr mining basin.

The rubber transmission discs allow a radial displacement when required as a result of forces set up by track irregularities, of about 12 mm (0.47 in.), limited by contact between the axle and the hollow shaft (see bottom, right, of figs

distortion of the rubber could be 30 % higher. The metal cover discs (on which the rubber segments are vulcanised) are fixed by means of bolts to the transmission segments mounted on the hollow shaft (inner plate) and on the axle (outer plate, in relation to the bogie longitudinal centre line).

With regard to the general arrangement of the DÜWAG transmission, the following may be stated : the gear case is in two parts for dismantling; in this case is the hollow shaft to which is connected

the large conical gear wheel (plate profile = « Tellerrad »). The conical driving pinion is located in the same gear case with provision for adjustment, as necessary, of the gears. The main part of the transmission (including traction motor) forms a complete unit which can be assembled and bench-tested indepently of its mounting on the bogie, which facilitates maintenance. At the ends of the hollow shaft are fitted crown plates, to which, as already stated, are fitted the rubber segments. On the pinion shaft is a coupling ring with internal teeth, providing the link with the armature shaft (« Zahnkupplung » of fig. 495). When connecting the transmission to the motor, these coupling parts slide, one over the other, and are locked in position by screws.

These are thus resilient segments which support the whole of the motor and transmission and transmit to the axle the driving or braking couple. Only the axle, therefore, is unsprung.

The presence of a single motor for driving the two axles has various advantages, particularly for relieving the load on the axles (full couple) when starting or braking; one can consequently count upon the full load of each axle for brake effect (calculation of speed reduction).

The ball mounted crown pivot has permanent lubrication, the gears run in oil.

The DÜWAG transmission, dealt with in various publications [363] can be classified amongst rubber mounted transmissions.

Finally, it can be noted that, in the first of the articles mentioned in note [363], the authors give a comparison (partly historical) between various modern *tramway* transmissions. Figure 1 thereof shows the Essen « simplex » bogie (see note [362]) and figure 2 the DÜWAG bogie; these two applications having one longitudinal motor driving two axles. On the other hand, the other three transmissions described, two transverse motors per bogie, each driving one axle, are thus correctly described as individual axle drives; figure 3 of the article in question deals with a transmission from a fully suspended motor (USC 323) developed in 1923 by the Krefeld Tramways and AEG; figure 4 shows an AEG project of 1928 with the hollow armature shaft (the first example of this kind?) and double reduction gears; the motor body being fixed to the bogie frame; lastly, figure 5 shows a motor (USH 5140, AEG) with hollow shaft in which the drive is effected to points on the trans-

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(363) See *V. & T.*, September 1951, « Bahnmotorantriebe für Nahverkehrs-Fahrzeuge », pp. 289-291, 5 figs., H. HERMLE & H. MECKE.

— *Techn. Mitteilungen (Organ des Hauses der Technik)*, Essen, No. 12, 1951, « Betriebliche Anforderungen an moderne Strassenbahnfahrzeuge », VOSSIUS.

— *V.D.E. Fachberichte*, Wuppertal, III/16, 1952, « Neue Wege in der Elektrotechnik für Strassen- und Vorortbahnen », E. HOLTGREVE.

— *V. & T.*, No. 8, 1951, « Gedanken über die Weiterentwicklung grossräumiger Strassenbahnwagen », Th. HELD.

— *Schiene und Strasse*, Dortmund, Jahrbuch 1953, « Der DÜWAG-Achsantrieb für vierachsige Strassenbahnwagen », Th. HELD.

mission shaft passing through the hollow shaft, by the use of a six-legged spider with rubber pads. This latter transmission in which the casing is mounted on roller bearings, for the gear wheel and pinion, can be classified with the transmission in Chapter VI [364].

CHAPTER V

DRIVING MECHANISMS BASED ON THE OLDHAM JOINT

This category [365] comprised in the first case only the so-called : universal » SLM Winterthur locomotive transmission, but others were later able to be included in the same category. However, with the increasing multiplicity of flexible axle driving mechanisms, it is often very difficult to attribute this or that mechanism to a definite category since, by certain of their components they can be equally well considered under one or even two other categories. We have already touched on this problem at the end of A) in Chapter IV, on the page following that with figure 462 [366].

Thus the two mechanisms dealt with in this chapter can also be classified as mechanisms with springs completely encased in the body of the gear wheel; the second (fig. 506) can also be classified as a cupped spring, of the quill cup drive type.

We have thus to mention here only two applications, that quoted in *Vol. II*, p. 183 (fig. 238), also pp. 285-287 (fig. 363 and 365) which could also be called, like that of Alsthom (fig. 430-432, etc.) a « floating ring » type (the Alsthom construction having a floating ring without springs, insofar as the latter are located on the geared rim) and that used in England and mentioned at the bottom of the page following figure 485 [367].

This is an SLM drive mechanism fitted to a single phase (20 kV, 50 cycles) locomotive, No. 6051 C_0-C_0, of the SNCF [368]. This machine was built by the SLM-Winterthur for the mechanical part and by Oerlikon (Zurich) for the electrical equipment [369].

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(364) The motor coaches of the Stockholm metropolitan (part of the Stockholm Municipal « Spärvägar » S.S.) (see *E.T.T.*, No. 7-8, 1949, pp. 117-119, fig. 8) have no hollow armature shaft but they have a segmental rack between the motor and the gears (see *Elektrotechnische Zeitschfrift*, *ETZ*, Germany, No. 21 of 1950).

(365) See *Vol. I*, pp. 60-67 (fig. 126-139) and *Vol. II*, pp. 165-183 and 279-288 *Congress Bulletin*, November 1948 and January 1950).

(366) *Congress Bulletin*, November 1954, p. 1070, first column.

(367) *Congress Bulletin*, November 1954, p. 1096.

(368) This locomotive, in service on the Aix-les-Bains-Annecy-La Roche-sur-Foron line (80 km = 50 miles) will be given a new series number, 20001 (instead of 6051), as soon as the single phase line tension, at 50 cycles, has been raised from 20 to 25 kV.

(369) See *R.G.C.F.*, Nov. 1951 (Special number of the « Journées Techniques d'Information » in connection with the 50 cycle single phase electrification, Annecy, 12-15 Oct. 1951), pp. 690-695 (10 figs. and diagrams, 4 tables).

See also :

— *Bulletin de l'Association Suisse des Electriciens*, *SEV*, Zurich, 30-9-1950, « Elektrische Traktion mit Einphasenstrom 50 Hz », pp. 733-751, 25 figures, L.H. LEYVRAZ.

— *Bulletin Oerlikon*, Zurich, No. 285, September/October 1950, pp. 2079-2080, 5 figures,

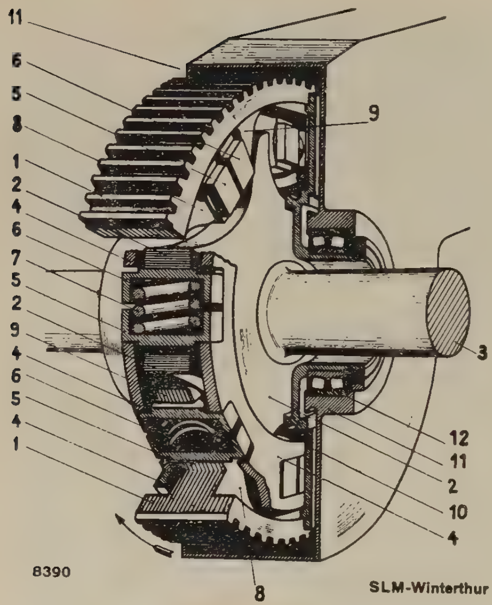


Fig. 500. Sketch of SLM floating ring drive.

1 = geared rim;
2 = axle driver;
3 = axle;
4 = floating ring;
5 = rear (or forward, according to direction of travel) cup, actuated by geared rim;
6 = rear (or forward) spring cup, bearing on the two floating rings (at each side of the gear wheel);
7 = spring of the flexible transmission unit;
8 = rear (or forward) driving arm;
9 = forward (or rear) driving arm;
10 = gear wheel retaining plate forming hollow stub shaft;
11 = gear case;
12 = roller bearing.

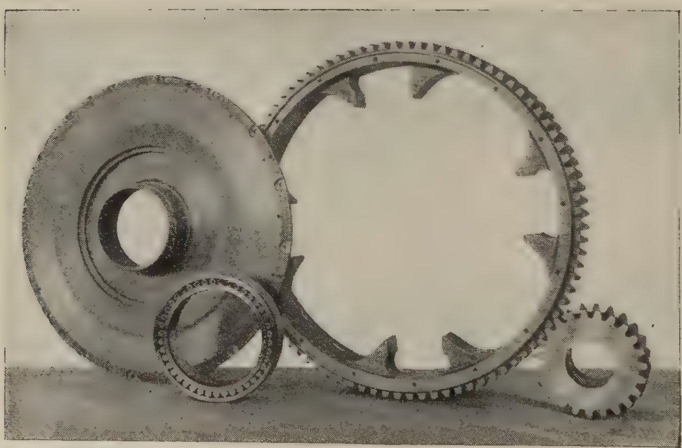


Fig. 501. — Component parts (without springs or floating rings) of SLM floating ring flexible transmission, as made for the engine in figs. 502 and 503. Left to right (see fig. 500), 10, 12.1 with 8 and 9, pinion.

Photo SLM—78 ~4

« Die CoCo-Lokomotive Nr. 6051, 4300 PS für Einphasenstrom 50 Per/S. der Société Nationale des Chemins de fer français (SNCF) », L.H. LEYVRAZ.

— *Electricité* (Published monthly by « Science et Industrie »), Paris, May 1951, « La Locomotive électrique CoCo 6051 à courant monophasé à 20 kV, 50 Hz », pp. 133-138, 9 figs., L. DEVAUD & M. GAIDE.

— *R.G.C.F.*, July 1951, « La Locomotive CoCo 6051 à courant monophasé 50 Hz de la SNCF », 24 pages, 33 figures, 5 tables, C. BODMER, G. BORGEAUD, P. LEYVRAZ and G. DEGEN.

Fig. 502. — Single phase locomotive No. 6051 (renumbered 20001 for 25 kV) S.N.C.F., 20 kV, 50 cycles, 1951, at Annecy Station.

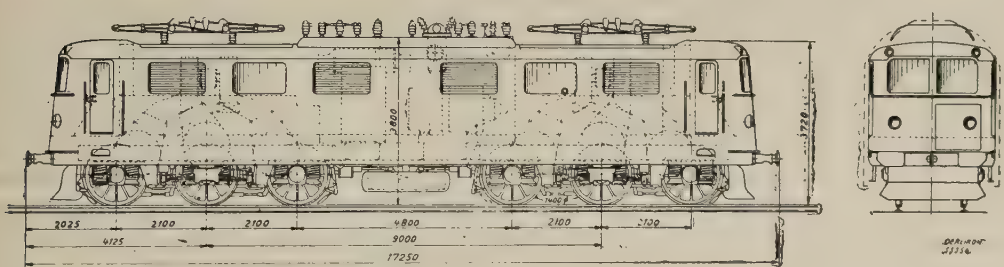


Fig. 503. — Dimensioned sketch of locomotive in fig. 502 (replacing fig. 238).

— *Bulletin de la Société française des Electriciens*, Paris, September 1951, series of articles dealing with single-phase 50 cycle traction.

— *Rendiconti dell'A.E.L.* (Association Electrotechnique Italienne), Milan, September 1951, « Trazione elettrica a corrente monofase 50 Hz », 4 pages, 3 figures, L.H. LEYVRAZ & G. GARZETTI.

— *Le Génie Civil*, Paris, 15-10-51, « Les essais de traction électrique en courant monophasé 50 Hz de la SNCF ».

— *World Power Conference*, New Delhi, 1951, The development and the present state of electric traction with single phase current of 50 cycles, L.H. LEYVRAZ.

— *E.B.*, March 1952, « 50 Hz-Tagung in Annecy ».

— *Oesterr. Zeitschrift für Elektrizitätswirtschaft*, Vienna, 1952, « Die elektrische Zugförderung mit 50 Hz in Frankreich ».

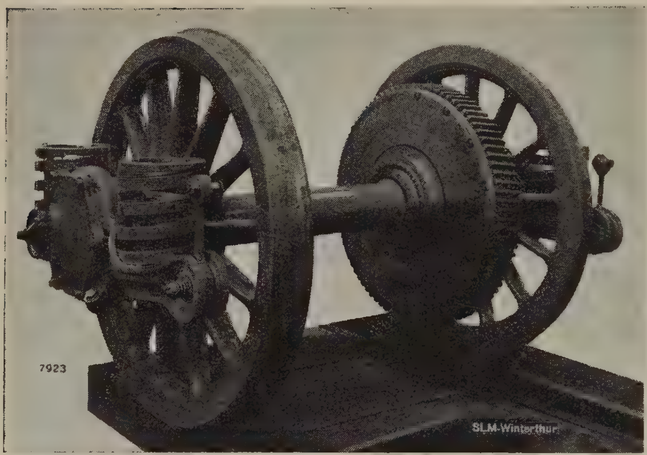


Fig. 504. — Driving axle complete with suspension and transmission encased in the gear wheel; for the locomotive in figs. 502 and 503, cf. fig. 458.

Figure 500 shows a sketch of this mechanism as applied to SNCF locomotive No. 6051 and figure 501 shows the component parts.

Figures 502 and 503 show the locomotive in service, and a diagram with dimensions (replacing the provisional 1948 diagram, fig. 238); figure 504 shows an axle, fully fitted, from which it can be seen that the whole of the flexible drive mechanism is completely encased in the body of the gear wheel. This arrangement is similar to that of many other applications, as for example those reproduced in figures 146, 147, 150, 190, 359, 361, 457, 480-481, etc.

Figure 506 is a sketch showing the arrangement of the suspension for the two pivot bogie and the suspension of the body from the bogie.

The working of this mechanism will not be described as it clearly emerges from what is established in Chapter V (*Vol. II*, pp. 282, 286, etc) and the legends of figures 500 and 501.

The fitting on a British Railways BR motor coach Express Unit 3059 class is similar, but has cups for the ends of the springs. The arrangement is shown in figure 506. This mechanism is fitted to two axles of a driving bogie on a coach identical with that of figure 486, with the same English Electric motors, flexibly mounted on the axle (fig. 482-485). Only the cup-drive transmission of figures 480 and 481 is replaced by that of figure 506, these also being completely encased in the body of the gear wheel. The driving bogie has therefore an external appearance similar to figure 487.

— *R.G.C.F.*, May 1952, «Essais de la locomotive monophasée à 50 Hz CoCo 6051 Oerlikon », 7 pages, 8 figures and diagrams, NOUVION.

— *Oesterr. Maschinenmarkt*, Vienna, 1952, « Die Bewährung der Vollbahntraktion mit 50 Hz-Einphasenstrom », C. BODMER.

CHAPTER VI

CARDAN TRANSMISSIONS

This Chapter was formerly headed « Driving mechanisms with hollow shaft and cardan joints with coupling by flexible steel discs or leaf springs in parallelogram or plates », and again comprises all these categories (370).

This transmission, which is shown in the drawings of figures 507 and 510, is at present fitted experimentally (prototypes) to seven motor coach sets similar to those of series 23071 (see figs. 284 and 287 of *Vol. II*) put into service in 1953. It has also been fitted on two prototype B_0B_0 locomotives of the SNCF, Nos. 9003 and 9004, the first of which was put into service in the spring of 1953. Figure 508 shows locomotive No. 9003 on a shed road; figure 509 the four assembled axles of this machine with their equaliser and primary suspension; figure 510 is a section through one of the axles, and figure 511 a dimensioned diagram of the two prototypes 9003 and 9004 (372).

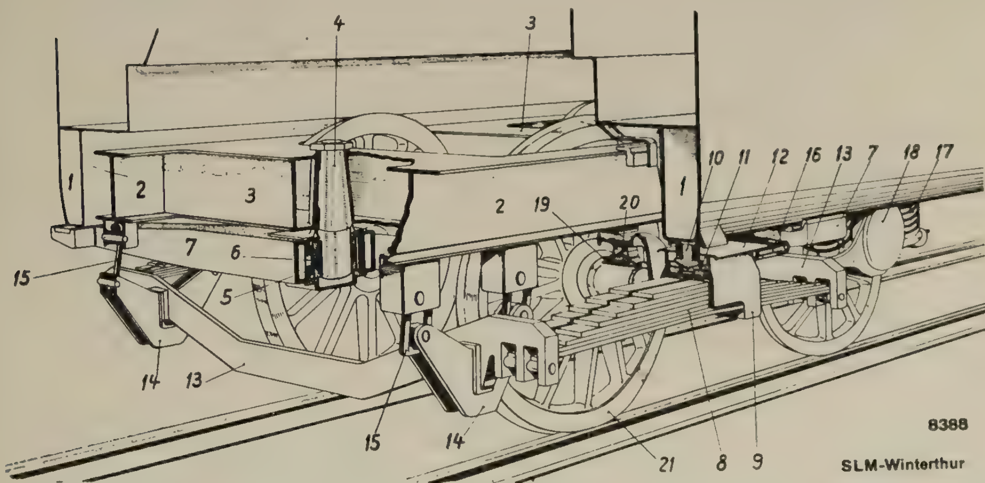


Fig. 505. — Sketch of suspension of 2 pivot bogie of machine in figs. 502 to 504. Cf. fig. 365, also figure on right of page 692 in the first publication of note (368).

At the time *Vol. I* appeared (1932-1933) there were no cardan transmissions, strictly speaking, apart from some tramway applications, several of which are shown in figures 185 to 196.

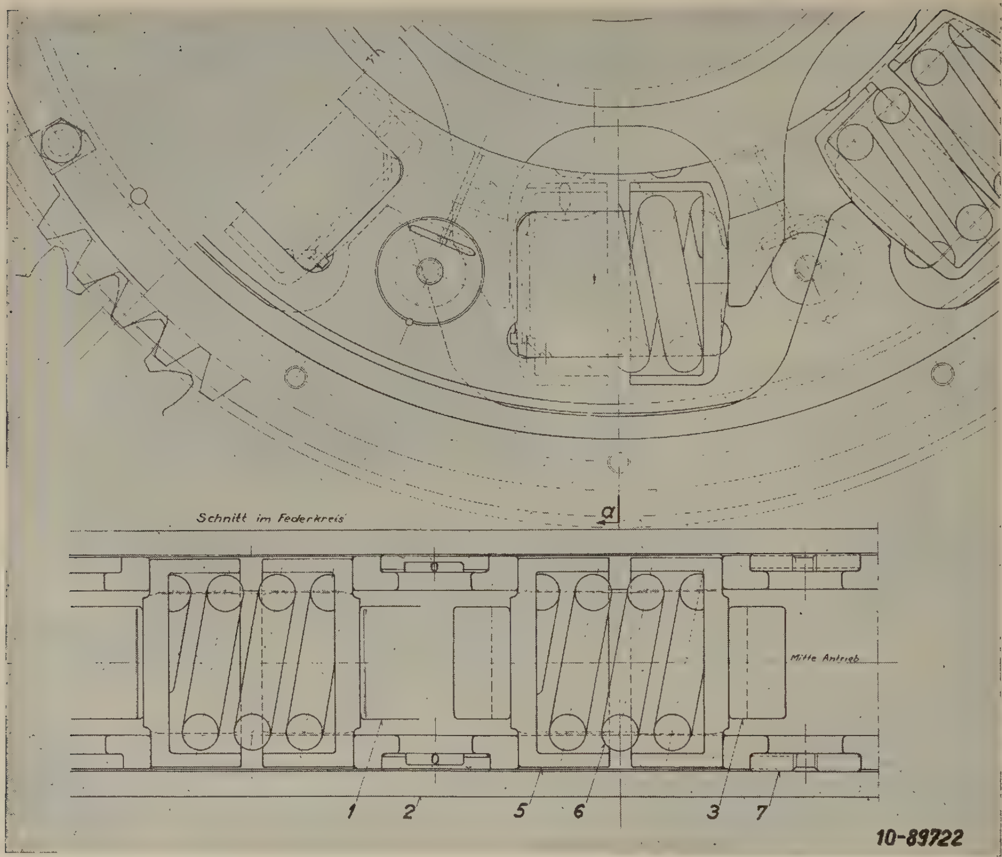
We will take this time the various types of cardan transmission in a different order and start with a new SNCF mechanism which we will call the « SNCF cardan mechanism » (371).

The SNCF cardan transmission for motor coaches can be described as

(370) See *Vol. II*, pp. 185-204 and 289-302 (*Congress Bulletin*, November 1948 and January 1950).

(371) Fitting by M. Jacquemin, Chef d'Etudes Principal de la SNCF, Division des Etudes de la Traction Electrique D.E.T.E., Paris.

(372) The blocks for figs. 510-516 have been kindly lent by the Association Française des Amis des Chemins de fer, AFAC; see note (373).

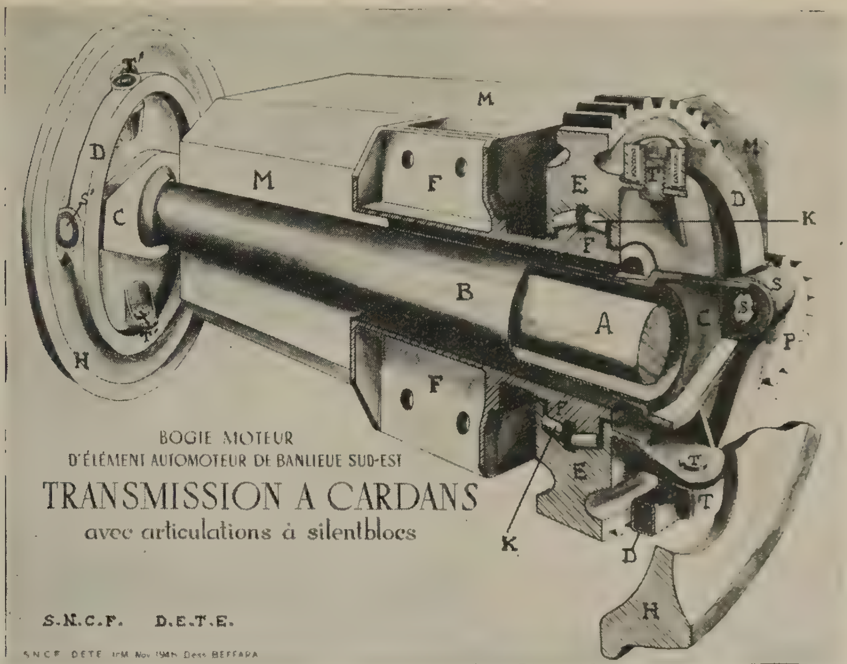


Plan SLM

Fig. 506. — Part of drive on British (BR) motor sets in figs. 486 and 487. Cf. fig. 500 and 501.

1 = 9 of fig. 500.
2 = 10 of figure 500.
3 = 2 of figure 500.
5 = 5 and 6 of figure 500.
6 = 7 of figure 500.
7 = fixing pieces for floating rings.
Schnitt im Federkreis = section through circular plane and spring centre line.
Mitte Antrieb = centre line of drive.

follows (see figs 507 and 510). The traction motor M is fixed at the nose end to the bogie middle-bearer and has at the other end of the body (axle end) a lateral bearing F, round which the gear wheel E rotates (corresponding to 14 and 16 of fig. 510). The hollow shaft B (17 of fig. 510) is provided at each end with two arms C, attached by silent blocs S and S' (15/19 of fig. 510) at each side to a ring D (15 in fig. 510), to which, perpendicular to C and to SS', is fixed by silent blocs T' (19 of fig. 510) the wheel on the side opposite to the gears and by the silent blocs T the large gear wheel E (16 of fig. 510). These fixing points T (13 of fig. 510) on the gear side pass through suitable holes in



SNCF drawing.

Fig. 507. — Diagrammatic sketch of S.N.C.F. (Jacquemin) cardan transmission for motor coach sets.

A = axle;
B = hollow shaft, rotating in the bearing F of the body of the motor M;
C = transverse arms fixed to the two ends of the hollow shaft B;
D = rings located at each end of the axle to which are fitted the ends of the arms C;
E = geared rim, running on the roller bearing K, in the gear case;
F = plain bearing, forming part of the body of the motor M;
H = driving wheels;
K = roller bearings carrying geared rim E;
M — traction motor with bearing F;
P = pinion (on armature shaft);
S = silent blocs joining the arms C to the ring D, gear side
S' = as S but on the far side from gears;
T = silent blocs joining ring D to geared rim E;
T' = silent blocs joining ring D to driving wheel H, far side from gears.

the wheel H (monobloc). The pinion P is rigidly fixed to the armature shaft.

The transmission works as follows : the gear wheel E (geared rim 13 of fig. 510) driven by the pinion P, turns on a Timken double roller conical bearing on the bearing F (14) and in turn drives through silent blocs T (19) the ring D (15) (gear side). This ring drives the arm C (still on the gear side) at the end of the hollow shaft. The corresponding arm C at the other end of the hollow shaft in turn drives through silent blocs S' the other ring (15 in fig. 510) (opposite side to gears), which finally drives the axle through the fixing points T' (15/19), also through silent blocs. This is a typical cardan transmission of the standard type, but the parts, in addition to transmitting the drive, ensure the *lateral link between the axle and the frame*, which allows the frame and axle-

boxes to be simplified because the latter carry only the vertical load and have no lateral guiding function.

We may point out that figure 507 shows diagrammatically the principle of this cardan transmission, whilst figure 510 shows it as fitted to locomotives 9003 and 9004.

Before passing on to a description of the prototype locomotives 9003 and 9004, we can state with regard to new motor sets that, on 54 units ordered (series Z 5101-5154, South-East Region, comprising one driving and one trailing A + R) the SNCF has decided on the following experimental fittings :

a) 45 motor coaches with nose suspended motors, 42 with ordinary wheels and 3 with SAB wheels (see figs. 404 and 406);

b) 2 motor coaches with nose-suspended motors, but with Alben-SW-I transmission (see figs. 450-453);

c) 7 motor coaches with full-suspended motors, SNCF cardan transmission and rubber anti-vibration mountings.

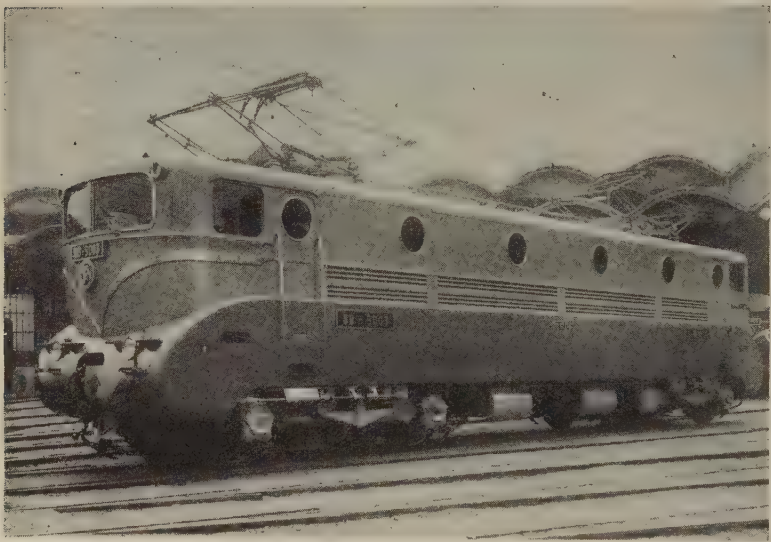


Fig. 508. — SNCF BoBo locomotive No. 9003, with SN CF cardan transmission (fig. 510) and Oerlikon motors at Charolais (SE) depot, Paris. Cf. fig. 511.

Photo SNCF nº 2092.

We now pass to the prototype locomotives Nos. 9003 and 9004 of the SNCF (figs. 508 to 511). These machines are quite new in arrangement and design and are a considerable advance on anything so far done in the world of electric traction. We can refer to existing publications ([373]) and mention briefly the main

([373]) See *R.G.C.F.*, Nov. 1953, « Les locomotives électriques à grande vitesse BB 9003/9004 », pp. 589-606 (for the motors 607-612), 25 (plus 7) figures, diagrams and tables, DUFÊTRE, COUREAU, COTTIN, HEIDMANN (BODMER, ROSSIGNOL).

Earlier articles :

— *R.G.C.F.*, June 1952, « Nouvelle conception mécanique pour une locomotive électrique

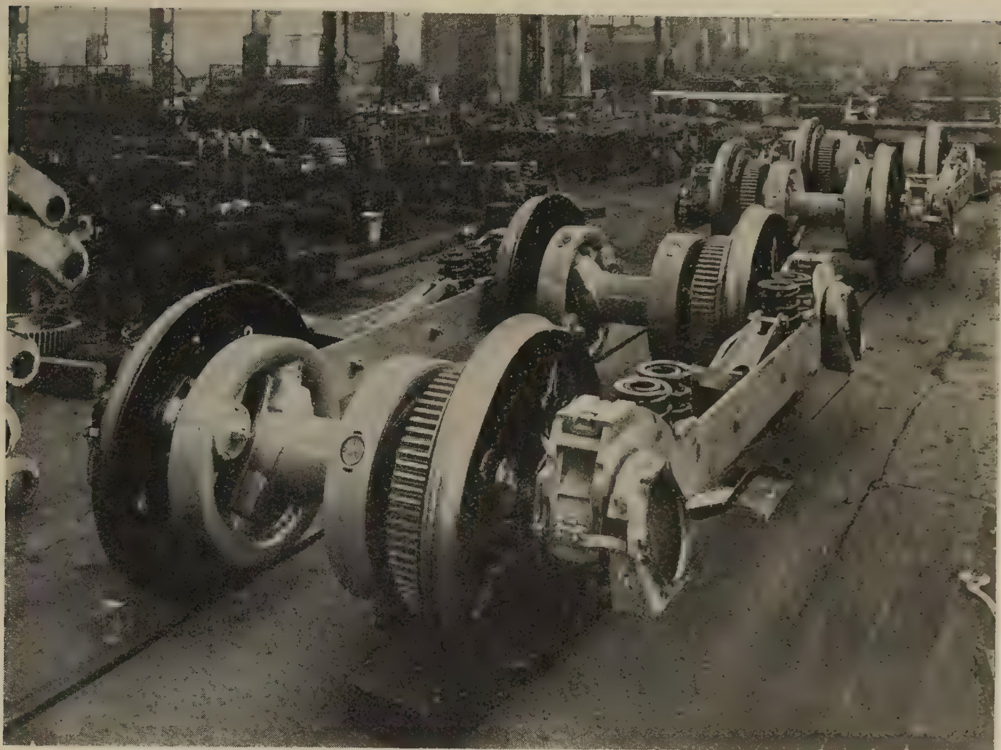


Photo SNCF. O. 3702.

Fig. 509. — Set of wheels, without motors or intermediate gears, for the two bogies of the locomotive in fig. 508, showing the cardan transmission of locomotives 9003 and 9004 with the « swan-neck » coupling and Isothermos boxes, also the primary suspension springs (fig. 512*b*). This set of wheels with the transmission was manufactured at the F.A.C. workschops (Schneider-Le Creusot).

The transmission ensures the lateral link between axle and frame. It will be seen that the gears are both on the same side of the bogie. The other bogie has gears on the opposite side.

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de vitesse », 14 pages, 13 figures, table and diagram, A. Jacquemin, reproduced in the *Bulletin T.E.*, Nos. 3 and 4, 1953.

— *A.F.A.C.*, No. 169, July/August 1951, « Les locomotives électriques à grande vitesse BB 9003 et 9004 de conception française », 8 pages, 15 figures, tables and diagrams, D. Caire, A. Gache.

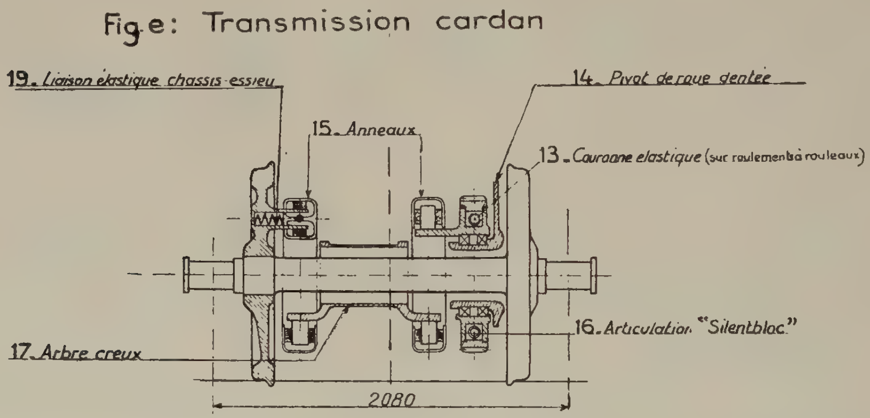
For the BB (and CC) machines of the Valenciennes-Thionville line, SNCF, North-East, see : « L'électrification des Chemins de fer » (*Science et Industrie*, supplement to « *Electricité* », 1953, No. 195*bis*), article « Les locomotives monophasées 50 Hz de Valenciennes-Thionville », pp. 119-122, figs. 9-16, F. Nouvion.

The same issue of *Science et Industrie* gives on pages 46-47 a description (with 8 figures some of which have not been reproduced before) of the mechanical parts and transmission of the BB machines Nos. 9003 and 9004, P. Lothon; finally, also for 1.5 kV D.C. the transmission for the motor coach sets for South East (Paris) suburban services, pp. 49-50, 6 figures, P. Lothon (see figs. 476 and 507).

new features which differ from anything so far, having regard to figures 512 to 516 :

1) all bogie gears are located on the same side, and consequently the two motors on the opposite side (see figs. 512*a*, 513, 515 and 516);

3) the two motors of one bogie are underslung and can be coupled together (and synchronised) by an accessory gear wheel between the two pinions (see 11 of fig. 512*a*) (375). The drive is then no longer quite separate for each axle and we have mentioned



Cliché AFAC.

Fig. 510. — Section through axle centres, locomotives BoBo 9003 and 9004 S.N.C.F., showing the arrangement of the cardan transmission. Cf. figs. 507, 509 and 513.

N.B. — « Fig. *e* » is the key used in the second publication mentioned in note (373).

19 = frame/axle spring link;
14 = gear wheel pivot;
15 = rings;
13 = geared rim (on roller bearings) ;
16 = silent bloc joint;
17 = hollow shaft.

2) the two motors are located in the centre of the bogie and practically touch in the middle of the bogie, to which they are fixed, as already described by a loose coupling; they consequently drive the corresponding axle through the intervention of an intermediate gear wheel (see figs. 512*a*, 513 and 516) (374);

at the end of Chapter IV (in connection with the DÜWAG transmission) the points relative to these divergences;

4) « coach » type suspension for the bogie, with two stages of springs, the second stage having hanger type mountings with rubber dampers (see figs. 512*b* and 512*c*);

5) traction is from the body (which is

(374) A similar arrangement was shown in figs. 310 to 312 of *Vol. II* (*Congress Bulletin*, November 1949), with regard to the Gr.E. 424 locomotives of the FS (Italy).

(375) The principle of this arrangement is shown in fig. 23 and 24 of *Vol. II* (*Congress Bulletin*, October 1947.)

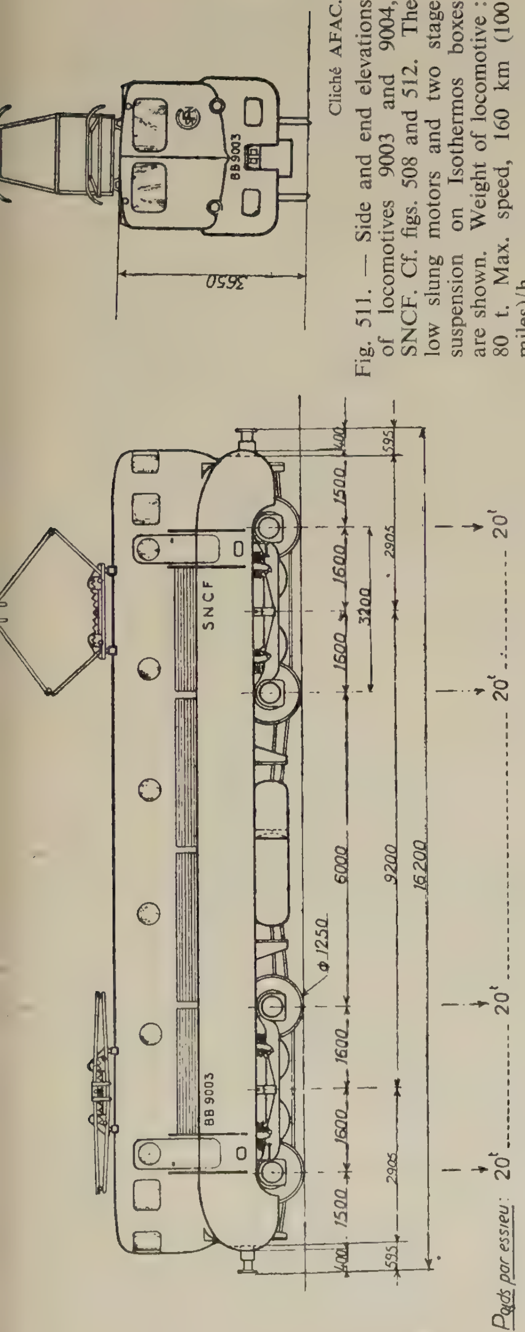


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Fig. 511. — Side and end elevations of locomotives 9003 and 9004, SNCF. Cf. figs. 508 and 512. The low slung motors and two stage suspension on Isothermos boxes are shown. Weight of locomotive : 80 t. Max. speed, 160 km (100 miles)/h.

frequently the case) and the drive in the bogies is underslung;

6) the longitudinal link between the axle and the bogies is, on each side, by a single rod with two silent blocs, connected to the equaliser and the frame (see fig. 512*c*); the lateral link of the axle to the frame is accomplished by the transmission itself, as already mentioned, this being the general rule for cardan transmission;

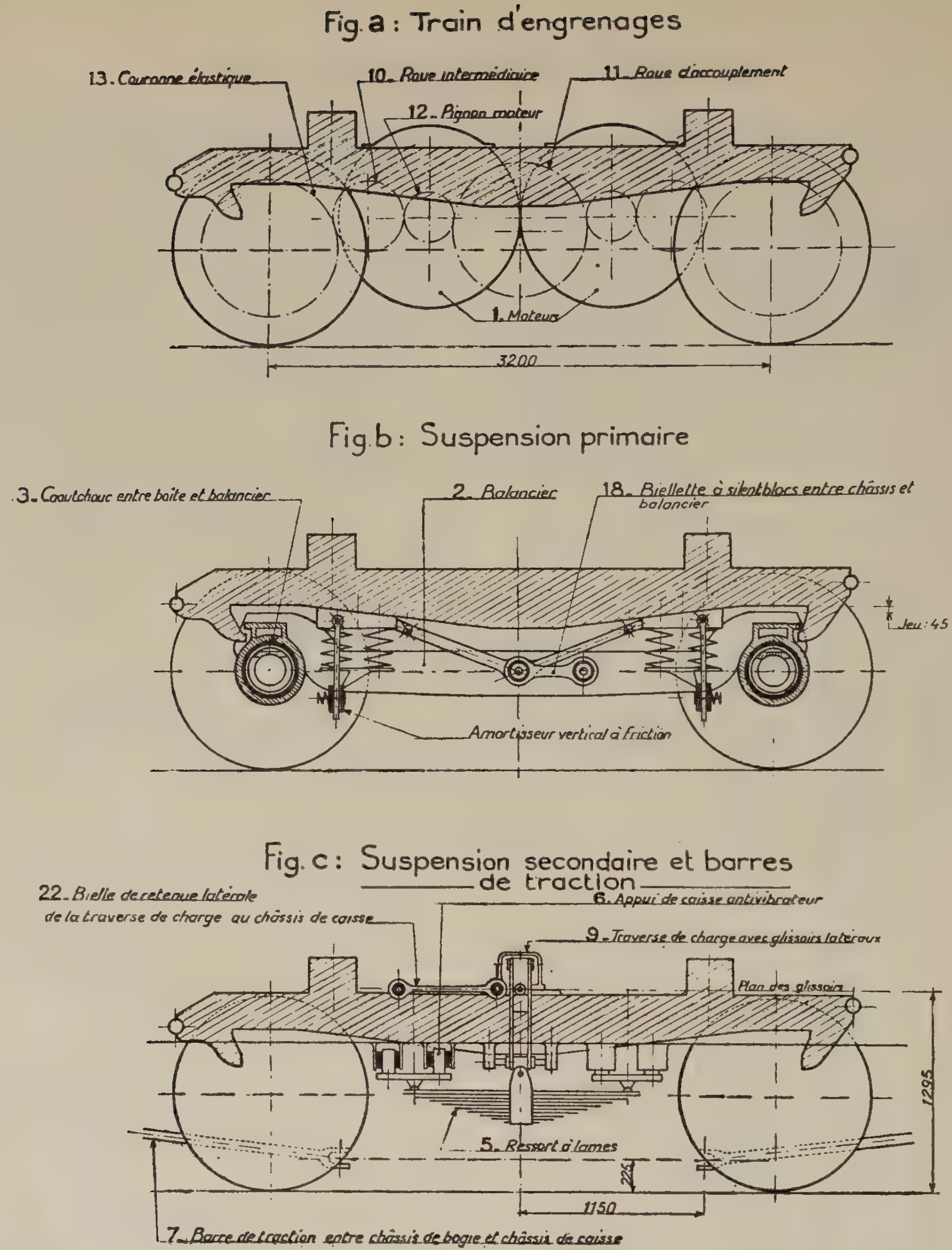
7) the machine is relatively long for a BB, 16.20 m (17.70 yards) overall, with a distance between pivots of 9.20 m (10.05 yards) (see fig. 511);

8) the bogie frame is extremely simple and comprises in one assembly the casing for all the gears (see figs. 515 and 516);

9) finally, the profiling of the body ends is greatly increased (fig. 511) in a similar manner to the ultra-rapid motor coach sets and the centre of gravity of the whole is as low as possible.

The behaviour on the track of locomotive No. 9003, which has been in service since 1953, is extremely good, and appears to be better than anything so far built.

The manufacturers are as follows : *mechanical parts* : Forges et Ateliers du Creusot F.A.C.; *motors*, for locomotive 9003, Oerlikon; for 9004, S.-W.; *electrical equipment* : Ateliers de Construction Electriques de Jeumont, F.A.C.E. The design of the mechanical parts (prototypes 9003 and 9004) has been directed



Cliché AFAC

Fig. 512. — Arrangement of motors and gears (*a*) primary suspension (*b*) and secondary suspension and traction rods (*c*).

Fig. a = gears;
13 = flexible rim;
10 = intermediate wheel;
11 = coupling wheel;
12 = motor pinion;
1 motors.

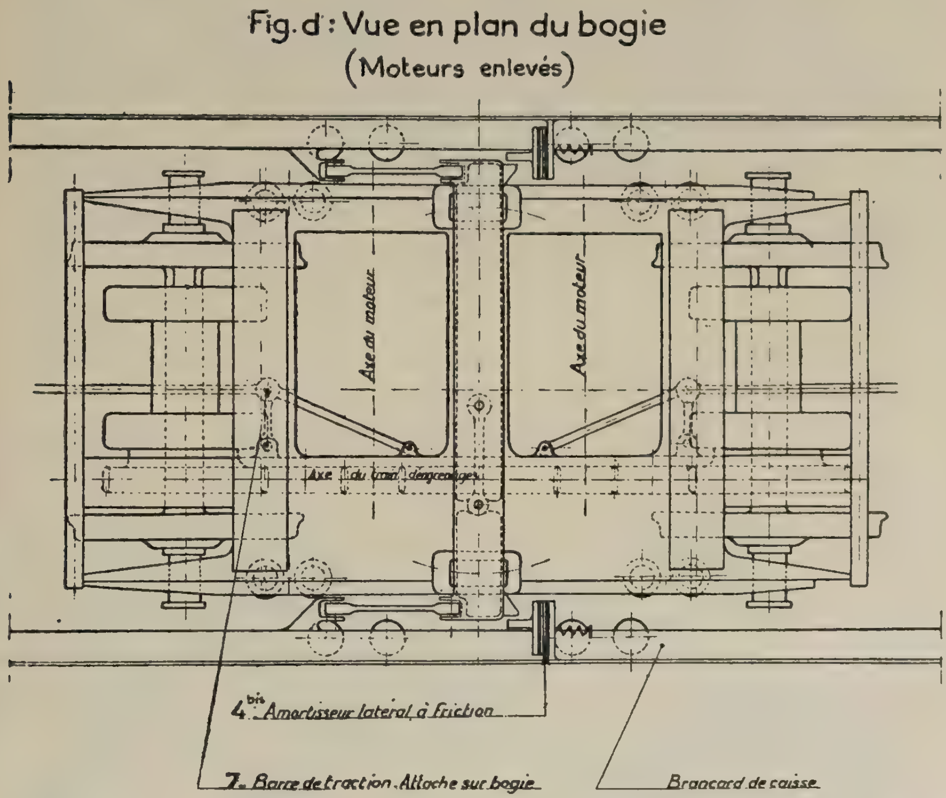
Fig. b = primary suspension;
3 = rubber between axlebox and equaliser;
2 = equaliser;
18 = silent bloc link between frame and equaliser;
Jeu = play.

Amortisseur vertical à friction = vertical friction type damper.

Fig. c = secondary suspension and traction rods;
2 = lateral retaining link between middle bearer and body frame;
6 = anti-vibration body bearing;
9 = middlebearer with lateral slides;
5 = laminated spring;
7 = traction bars from bogie frame to body frame;
Plan des glissoirs = slide plane.

by the SNCF, in close collaboration with the builders.

We may further note that this same cardan transmission (Jacquemin) is also fitted to 20 BB locomotives (15 with machines on the other hand (65 of which are single phase D.C. and 20, single phase/three phase) have small-sized motors laterally fixed on a loose arm with a rigid double reduction gear case, nose-suspend-



Cliché AFAC

Fig. 513. — Plan of complete bogie (without axleboxes) with body solebars. Cf. fig. 509, 510 and 512.

N.B. — Fig. *(d)* as in *N.B.* for fig. 510.

Fig. d = view plan of the bogie (without motors);
Axe du moteur = centre line of motor;
4*bis* = side friction damper;
7 = traction rod. Fixing to bogie;
Brancard de caisse = body solebar.

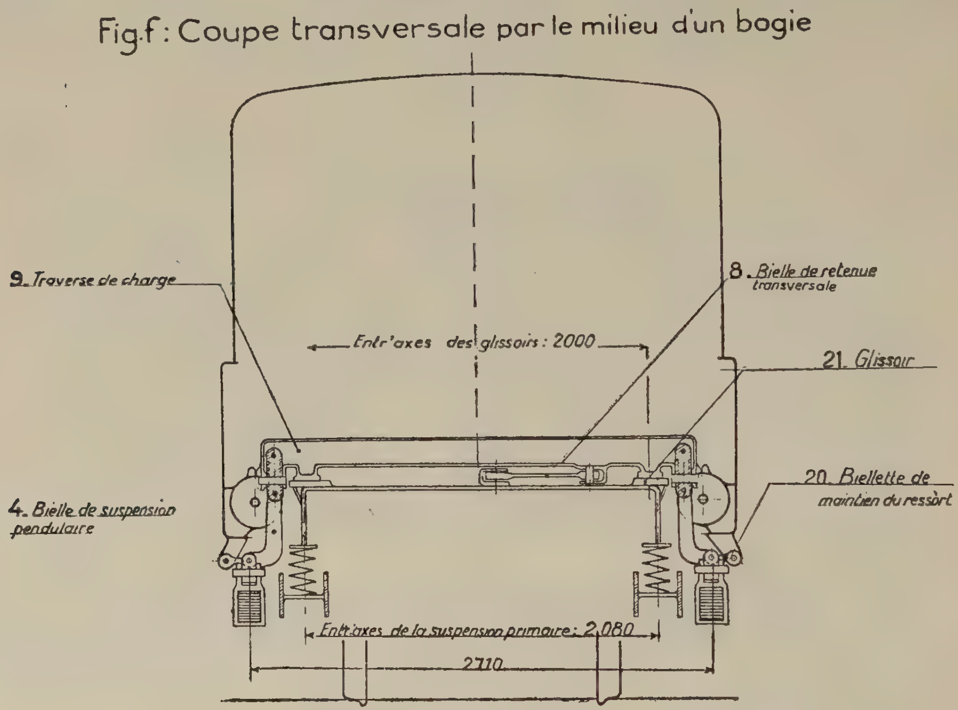
direct motors, 5 with ignitrons) of the line which is being electrified (1953-1954, single phase, 25 kV, 50 cycles) from Valenciennes to Thionville (SNCF, North and East Regions) (373). The 85 CC ed from the bogie frame, the other end carried on the axle through plain bearings [see fig. 9 of the publication mentioned under the fourth item of note (373) cf. also note (374)].

We now pass to the *cardan shaft and leaf springs* of the Secheron, SAAS, Geneva, this transmission having had, we believe, the largest number of applications during these last years. In *Vol. II* (376) this transmission has been designated the Secheron IV (377). It may be noted that there are two types, viz :

a) the mechanism which comprises a hollow cardan shaft surrounding the axle, with a single-sided leaf spring coupling (principle of fig. 372, *Vol. II*);

b) the mechanism which comprises a cardan shaft through the hollow armature shaft, with two leaf spring couplings, i.e. bilateral (principle of fig. 258 of *Vol. II*).

We will no longer differenciate between



Cliché AFAC.

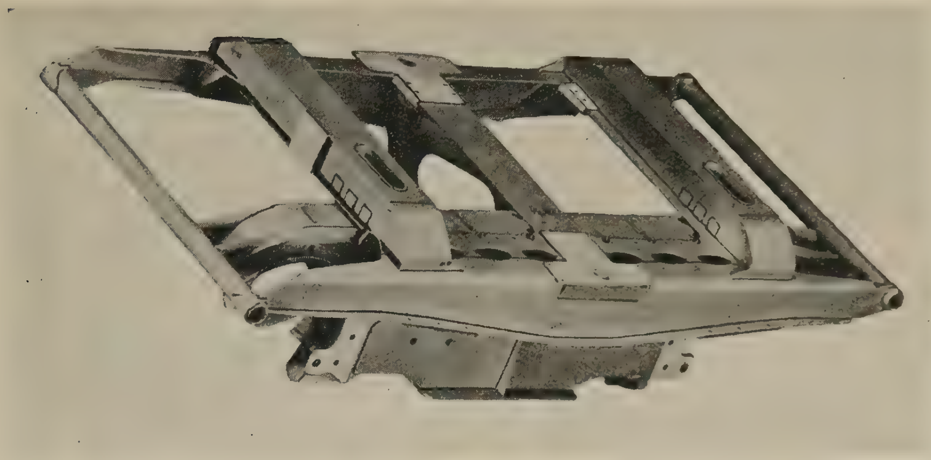
Fig. 514. — Cross section, locomotive in figs. 508 to 511 through axis of symmetry of bogies. Cf. figs. 512*b* and *c*.

N.B. — Fig. *f* as in *N.B.* for fig. 510.

9 = bogie middlebearer;
8 = side retaining rod;
21 = slide;
20 = spring retaining link;
4 = spring hanger;
Entr'axes des glissoirs = distance between slide centres;
Entr'axes de la suspension primaire = distance between centres of primary suspension.

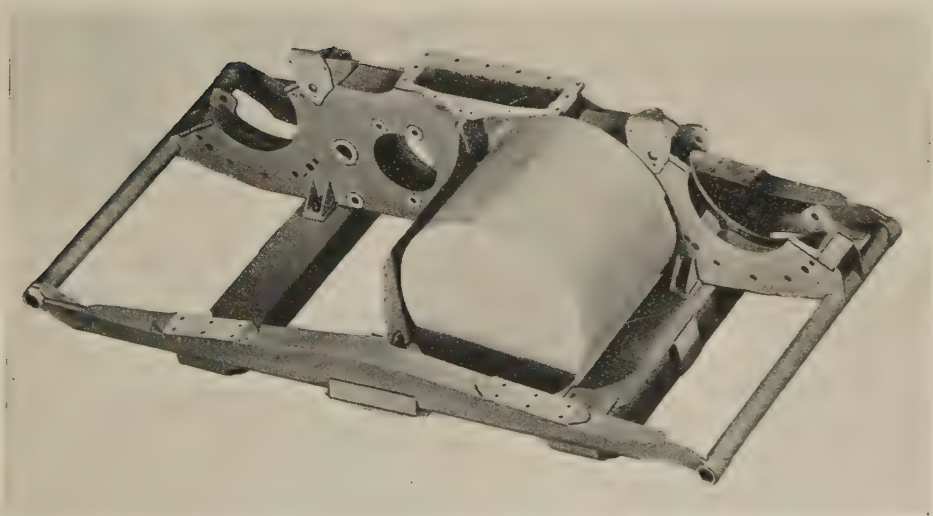
(376) P. 294 (fig. 374 and 375) (*Congress Bulletin*, January 1950).

(377) On page 292 and in figs. 372 and 373 of *Vol. II* (*Congress Bulletin*, January 1950, p. 30), this transmission was erroneously described as Secheron III which is the transmission shown in figs. 194-196.



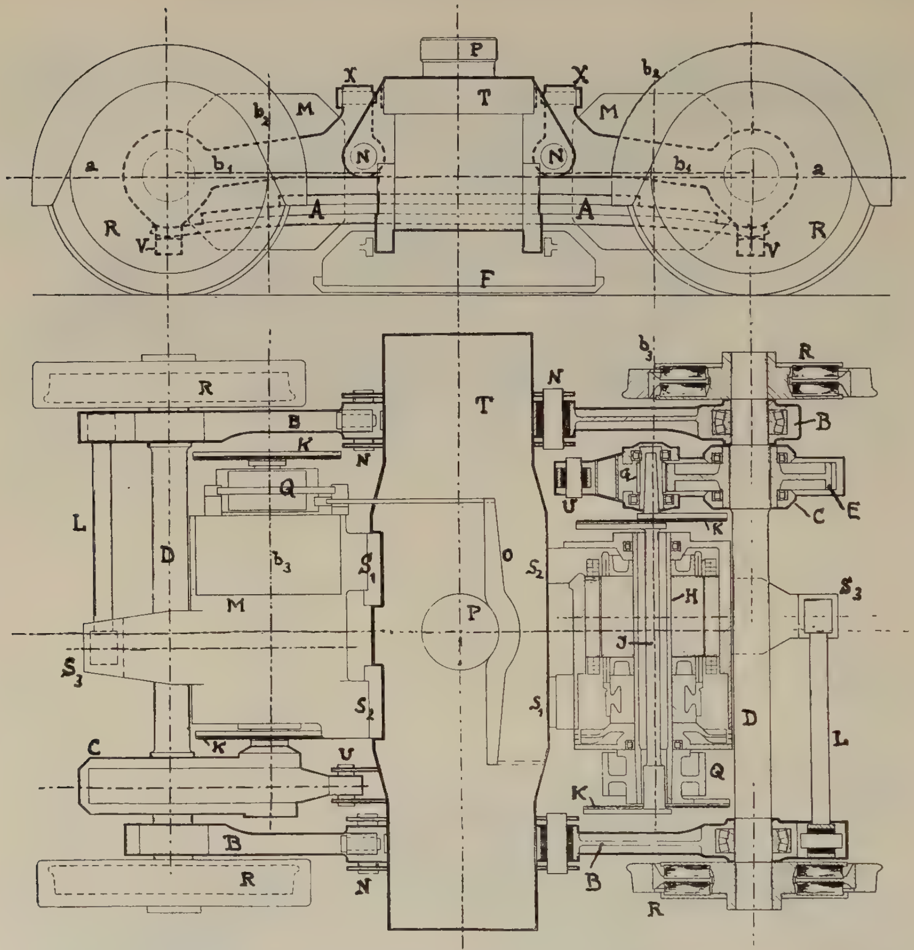
Cliché AFAC.

Fig. 515. — Model of bogie frame for locomotive figs. 508-511.



Cliché AFAC

Fig. 516. — Same model as fig. 515, reversed and showing (by cylinder) the location of one of the two motors.



Plan SAAS nº 518.

Fig. 517. — Elevation, plan and section of bogies, fig. 376, of motor coach 571, Rotterdam R.E.T. (Cf. figs. 374 and 375).

a = longitudinal plane through axle centres;
b_1 = longitudinal horizontal plane through traction motor M and pinion;
b_2 = vertical centre line of motor;
b_3 = transverse centre line of armature, cardan shaft and pinion, in stopped position;
A = longitudinal springs fixed in bogie transom T (bogie frame) and carrying at the ends the fixing V for the axleboxes;
B = carrier arms with roller bearings on the axles and pivoting at N from the bogie transom T;
C = gearcase (on roller bearings, pivoting at U);
D = axle;
E = gear wheel, keyed to axle D;
G = pinion, fixed to springs K of cardan shaft J;
H = hollow armature shaft;
J = cardan shaft passing through hollow shaft H of armature and carrying at the two ends the leaf-couplings K;
K = leaf-springs K transmitting through the cardan shaft the couple from the armature to the pinion G;
L = transverse equalisers with silent blocs S_3 allowing pivoting of the body of the motors M by the carrier arms;
M = traction motors, fixed at 4 points, S_1 and S_2 to bogie frame (transom T);
N = pivots for axle/gears assemblies; limited movement by deflection of springs A and by the blocks X against bogie transom T.
O = brake rigging;
P = bogie pivot;
Q = brake drums;
R = SAB resilient wheels;
S_1 and S_2 = traction motor fixing points on bogie;
S_3 = outer pivot points between motor bodies M and arms B with silent blocs;
T = bogie transom;
U = silent block pivot of gearcase C, attached by link and silent bloc;
V = fitting points of axleboxes (inside) to springs A;
X = blocks to limit amount of pivoting movement of arms B carrying axle assembly.

the two types, the leaf-spring coupling itself being the same in both cases. Moreover type *a*) was used only at the start (example in fig. 373).

The first applications of the Secheron IV mechanism were on the EBT motor coaches of figures 187 and 373; then on the new motor coaches, high capacity, of the Neuchatel Tramways; TN, series 81, motor coach 571 of the Rotterdam R.E.T.; motor brake vans of the Swiss Federal Railways SBB - CFF - FFS, class $Fe^4/_4$, series 801, and finally on those of the Geneva Tramways C.G.T.E., series 701 (378).

The mechanism on the motor coaches series 81, of the Neuchatel Tramways (379) was shown in figures 259-261 (the latter showing the bogie with SAB wheels) and a description of them was included on page 204 of *Vol. II* (380); we may refer to the publications in notes (152) to (154). The mechanism of coach 571 of the Rotterdam R.E.T. (fig. 374 to 376) has already been simplified (see pp. 295-296) and resembles recent applications. We show in figure 517 a plan, elevation and section through the driving axle horizontal centres of one of the bogies of the Rotterdam motor coach in figure 376 *(Vol. II)* (381).

With regard to the motor brake vans $Fe^4/_4$, series 801, of the CFF (figs. 66*a*, 66*b*, 128*a* of *Vol. II*, then 44 and 523) (382), we can give the following 11 figures, in 4 groups : 518*a*, *b*, *c* and *d* (modified bogie, axles, gears); 519 *a*, *b* and *c* (converted bogie and axles with motor mounted); 520*a* and *b* (traction motor) and 521*a* and *b* (gearcase and transmission component parts). These 11 photographs were taken by the Yverdon Works of the CFF where the coaches were fitted, and of which a dimensioned sketch is shown as stated in figure 444, the technical details being shown in the table at the right of this figure. Figure 128*a (Vol. II)* shows the old bogie which at first had nose suspended motors.

Motor coaches Nos. 803 and 819 were fitted in 1949, as noted in the legend to figure 444, with new bogies constructed by the SWS Works, Schlieren-Zurich, who have already been mentioned.

We will later deal briefly with the transmissions on the thirty motor coaches, Nos. 701-730 of the Geneva transport system C.G.T.E.; figs. 107*a* and 107*b (Vol. II)* show one of the driving bogies

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(378) PP. 202-204 and 294-296 (also dealing with the Rotterdam R.E.T.) of *Vol. II* (figs. 107*a*, 107*b*, 258-261, 374-376) (*Congress Bulletin*, November 1948 and January 1950).

(379) See *Bulletin Sécheron*, Geneva, No. 19F, 1947, « Les nouvelles motrices légères de la Compagnie des Tramways de Neuchâtel », 5 pages, 9 figures, P. GAIBROIS.

The mechanical parts and bogies of these Neuchâtel motor coaches were supplied by the « Société Industrielle Suisse SIG, Neuhausen near Schaffhouse. These coaches are similar in appearance to that shown in figure 250, but are bi-directional and have two exits on each side at the ends.

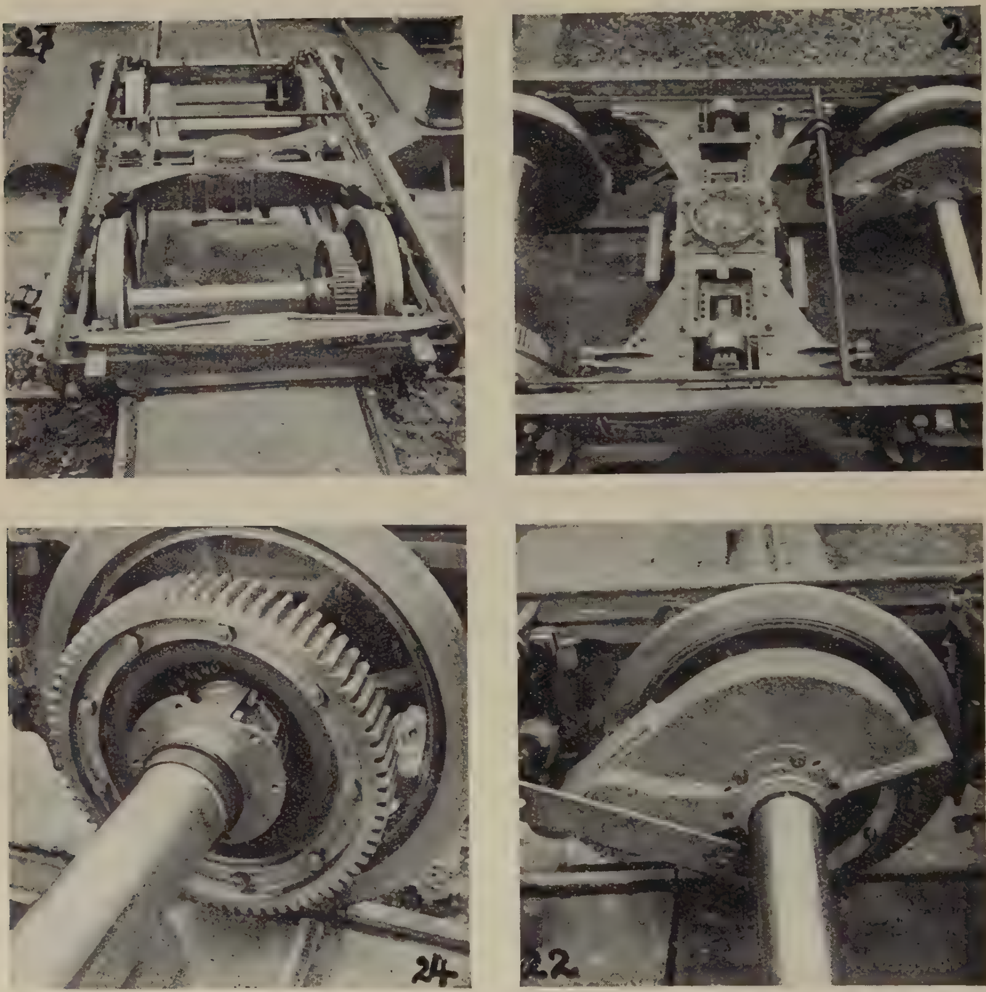
(380) *Congress Bulletin*, November 1948, p. 695.

(381) *Congress Bulletin*, January 1950, p. 34.

(382) See *E.B.*, Feb. 1929, p. 19, article by E.G. CHOISY.

— *Revue Technique Suisse S.T.Z.*, Zurich, No. 7/8, 21-2-1929, pp. 118-119 and 124, fig. 2 and 8 and table 1, in the article by A.E. MÜLLER : « Motorwagenbetrieb der SSB ». At the end of this article there is a very complete table of *all* CFF locomotives up to the end of 1928.

— *E.B.*, Nos. 5 and 6, 1932, pp. 101-107 and 225-233, article by F. STEINER.



a b c d

Photos CFF—Yverdon.

Fig. 518 *a*, *b*, *c* and *d*. — Converted bogie and axle of motor brake vans, fig. 444 (cf. figs. 66*a* and 66*b*, *Vol. II*).

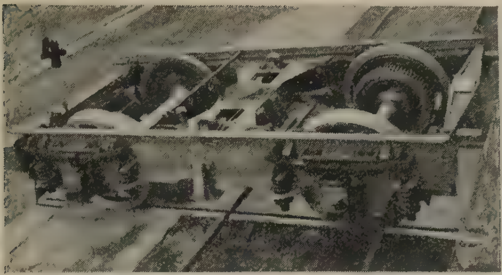
a (27) bogie frame with axles fitted. In the centre can be seen the two points for fixing the motor to the middlebearer;

b (2) side view of a, with, right, a gear case and carrier bar (*) coupling arm, and left, a bare gear wheel. On the transverse centre (on each side of the pivot) are the body roller bearings;

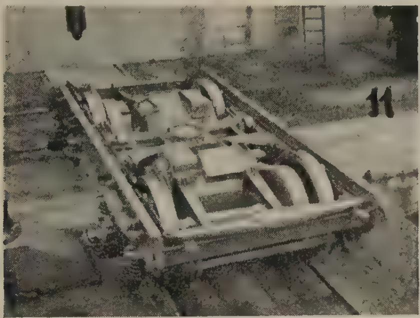
c (24) gear wheel with rim and bearing for securing of gearcase;

d (22) closer view of right-hand axle of b (2) with transmission arm keyed to pinion.

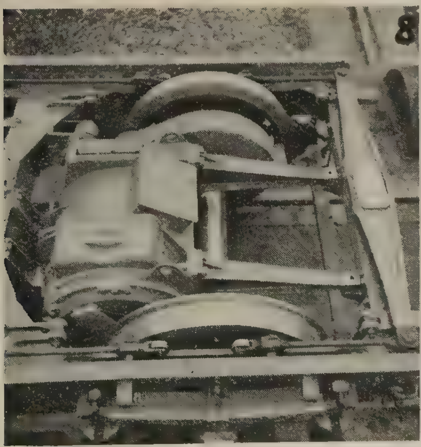
(*) Because of the absence of the motor, it is suspended from a rod, provisionally provided for the mounting.



a



b

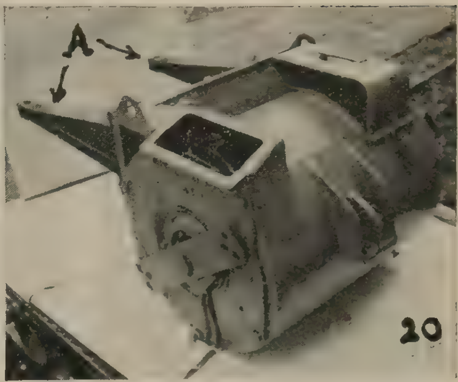


c

Photos CFF—Yverdon.

Fig. 519 *a*, *b* and *c*. — Bogies of figs. 444 and 518.

a (4) bogie without motors or gear cases;
b (11) bogie complete (with motors and gear-cases);
c (8) right of bogie in *b* (11) showing, right, the two carrier arms for the motor body against the bogie headstock and, left, the interior double seating bracket of 518 *a* (27). Behind the motor is the top joint of the gear case suspension link.



a

b

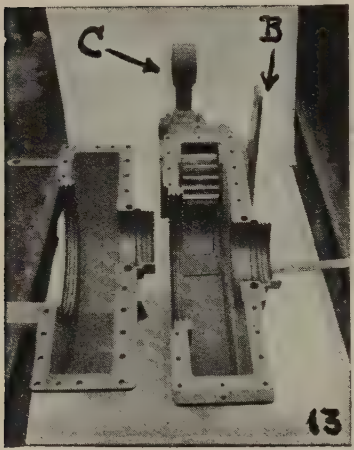
Photos CFF—Yverdon'

Fig. 520 *a* and *b*. — Traction motor of fig. 519.

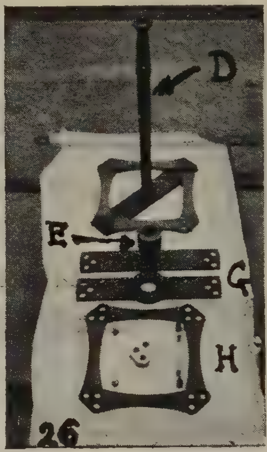
a (20 above) traction motor, viewed from gear side and bogie centre with transmission arms;
b (17 below) same motor, from side opposite to gears, with transmission leaves;
A = arms for fixing body to headstock.

complete and figure 371 the details of the flexible wheels, SAGA type, fitted to motor coaches and trailers.

Before mentioning other more recent applications, we can complete the description of the Secheron IV equipment as follows, by setting out some constructional



a



b

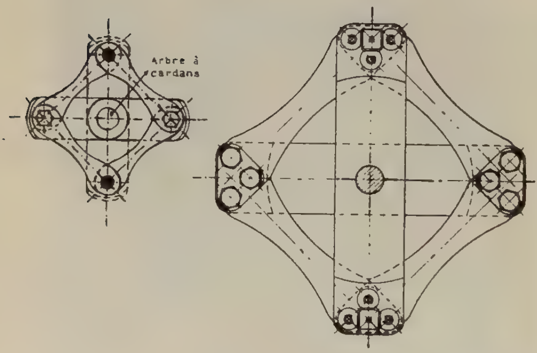
Fig. 521 *a* and *b*. — On the left are the two parts of the gear case (with pinion, carrier link C and transmission leaf B fixed to pinion shaft); right are the transmission components.

D = cardan shaft with leaf-spring frame;

E and G = driving arms;

H = leaf spring frame and fittings.

Photos CFF—Yverdon



Plan SAAS.

Fig. 522. — Sécheron IV transmission mechanism.
Left : type for smaller power;
Right : type for higher powers.

arrangements which are the basis of this mechanism's success :

A) the laminated coupling;

B) the gear case bearings on the axle;

C) the ribbed and grooved coupling.

The following remarks can be made :

ad *A*) : *the laminated couplings* are of special spring steel and their shape has been specially designed to give combined stresses as low as possible with high lateral flexibility; this flexibility which is lacking in various other couplings of the same type, is a great advantage as it allows where

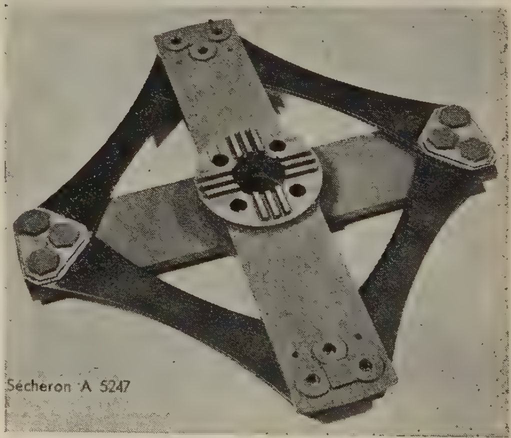


Fig. 523. — Special rubber and grooved coupling for Sécheron IV mechanism. This coupling is fitted for motor powers of 200 to 1 000 H.P. and above (locomotives).

This view shows the first one as fitted to the motor brake vans Fe $^4/_4$, series 801, of the Swiss Federal Railways, figs. 66*a*, *b*, 128*a* and 444 *(Vol. II)*.

necessary a certain amount of radial play to the axle; it also facilitates the mounting of the motor. In the direction of rotation the leaves are rigid; the cardan shaft, forming a torsion bar, gives the transmission a degree of flexibility in this direction; according to the size of the couple transmitted, the leaves have at each end one or more fixing holes (see fig. 522).

ad *B*) : *the gearcase bearings on the axle* are particularly accessible : they can be plain or roller bearings. If plain bearings are used, the arrangement and operation of the bearings are similar to those of nose-suspended motors : divided bearings which can easily be dismantled. If on the other hand roller bearings are fitted, they are available for inspection when the gear case is dismantled. Experience has shown that wear of plain bearings is extraordinarily small; this is the result of ample lubrication and the perfect sealing of the gearcase, which is preferably of cast steel. Despite the eccentric positioning of the bearing in the gearcase, there is no risk of the latter twisting; in fact the fixed point for the gearcase suspension lug is selected so as to avoid any flexing of the side wall of the gearcase.

ad *C*) : *a special slotted and ribbed coupling* (fig. 523) which greatly facilitates dismantling the motor is provided between the motor armature and one of the drivers to the first laminated coupling; a similar slotted and ribbed coupling can also be provided between the pinion and its driver and between the cardan shaft and one or other of its drivers. It is interesting to note in this respect that over some ten years or so, pinions and couplings have been pressed on to tapered ends of traction motor shafts and it has been considered that this type of mounting was the best and most solid; it undeniably gives satisfaction when the pinion can be shrunk on. Comparative trials have, however, shown the superiority of the slotted and ribbed coupling over the taper seat. In fact, the former transmits without distortion a couple which is a multiple of that transmitted by the latter; for this reason the slot and rib coupling is used beneficially for high powers of 200 to 1000 H.P. and above. At the same time, another problem is resolved, which often gives rise to difficulty : this concerns the degree of taper for the pinion seat when the pinion is pressed on; there is no certainty in this case of the play which will exist in the seat when the mounting is complete, and as is known, the limits between which this can vary — in the region of some hundreths of a mm — are very tight.

(To be continued.)

[656 .2 (44)]

The S.N.C.F. is reducing the number of double lines on its system,

by M. Marchand,

Ingénieur en Chef à la Direction du Mouvement de la Société Nationale des Chemins de fer français.

(Revue Générale des Chemins de fer, April 1954.)

In 1938, when the S.N.C.F. was set up, its railway system covered 42 500 km (26 100 miles) of lines, about 50 % of which (20 900 km — 12 986 miles) were double track, which is a relatively high proportion when compared with other railways of the Continent of Europe (Germany, 34 %; Italy, 28 %; Switzerland, 42 %).

During the war and after the hostilities, double track lines were reduced to single track lines and mostly retained as such, so that by 1950 the double track system of the S.N.C.F. had been reduced to 17 900 km (11 122 miles) (1).

Moreover, on account of the economy drive, the S.N.C.F. drew up an additional programme for changing over to single track covering about 2 200 km (1 367 miles) of lines, a programme which was to have been completed in part during the years 1953 and 1954.

This lightening of the structure *which covers one quarter* of the pre-war double track system represents an effort unprecedented in railway annals, on account of its magnitude, and it did not leave the railway world indifferent; it has led to lively controversy on the S.N.C.F. itself.

Misunderstandings, we hope involuntarily, arose, which have led to confusion in people's minds; for this reason, although it is a self-evident fact, we must make it quite clear that there is absolutely no similarity between turning double track into single track and closing down a line.

Alteration to single track is not a come down; it is a technical contraction, not a « resignation », since the railway remains and is always in a position to assure with the single track remaining all the traffic given it by the local industrial and commercial firms; such an operation does not therefore involve turning down any traffic as might be apprehended, often with reason, in the case of complete giving up.

Naturally, from a purely sentimental point of view it might be regretted that the S.N.C.F. is giving up good-naturedly any part, no matter how small, of the equipment it has been operating; nor is there any doubt but that double track operating is much more convenient and offers much greater facilities than single track operating.

It must not be forgotten however that under present conditions of intense competition with other methods of transport, kept alive by uncreasing technical progress and aggravated by unfair treatment, the railway is in fact « fighting for its life » and all considerations of prestige or convenience must give way before increased productivity.

Now, it is a fact that in the cost of transport, the cost of maintaining the track is far from negligible, and depends much more on the actual mileage than on the amount of traffic.

It is therefore an advantage to suppress all tracks which are but little or insufficiently used, since the railway cannot, like other industries, wrap up its excess installations in a « cocoon »; in this connection, the

(1) Including the suppression of about 100 km (62 miles) of double track.

The French National Railways 1954. Map showing double lines.

——— lignes maintenues à double voie.
—·—·— lignes dont la mise à voie unique est réalisée.
|·|·|·|·| lignes dont la mise à voie unique est décidée.

——— double traek. —·—·— converted to single track. |.|.|.|.| to be converted to single trcck.

operating department during the last few years has made great simplifications in the station equipments, and it is equally justifiable to simplify the installations on the line, i.e. to suppress the second track in the case of double tracks with little traffic whenever such a measure can be considered acceptable for the services involved.

Before going into details on the programme already completed or under consideration, we think we should reply to two questions which have often been asked, namely :

— how can one explain the fact that a fairly large proportion of a double track system built at great cost by the Companies can now be held to be more suitable for single track?

— are the savings obtained by turning secondary lines into single track sufficiently great to justify the inconveniences of a less flexible operating system?

CAUSES OF THE TRAFFIC DECLINE ON THE SECONDARY DOUBLE TRACK LINES.

To make the matter quite unequivocal, we must make it clear that the operation of converting to single track already realised or to be completed shortly by the S.N.C.F. is merely the recognition of an actual situation, i.e. the lines in question are lines on which the traffic has remained stable at a relatively low level for several years, and not lines on which conversion to single track would imply a lowering of the standard of service.

If most of the lines affected by the programme have suffered from a falling off in traffic, the causes of which we are going to examine, there are nevertheless certain double track lines which have never had anything but a low traffic level.

Probably, when they built these lines, the Companies concerned were influenced :

— either by the difficulty of single track operating at a time when telecommunication was practically non-existent;

— or by the desire of the Government to have available greater strategic possibilities;

— or, finally, by the hope of a rapid increase in railway traffic, whereas hopes founded on the development of local industries were often never realised, often on account of the fact that by making transport available, the railway favoured industrial concentration to the detriment of regional industries.

In the case of lines where there has been a definite decline in traffic, the reduction has been due, in part, to road competition which has particularly affected, at least in its origins, transport over short or average distances; consequently lines which were essentially the carriers of a local traffic were proportionally more affected than other lines, especially when the decrease in traffic was so great as to lead to the total suppression of the passenger services, on account of the co-ordination programme.

It should however be noted that many double lines formerly were also used by a considerable amount of traffic in transit (by traffic in transit we mean all traffic other than purely local transport), which being in the main long distance traffic was for a long time not much affected by road competition. It is therefore in the considerable change that has occurred in this traffic in transit that we must look for the reason why the traffic has fallen off on certain double lines and this has been directly due to the absolute earthquake that took place about 1930 in railway transport.

Up to that date, the traffic handed over to the railway had regularly increased at a rapid rhythm which remained well above the progress made in the technical field (power of the locomotives) and with the rolling stock (useful load of wagons).

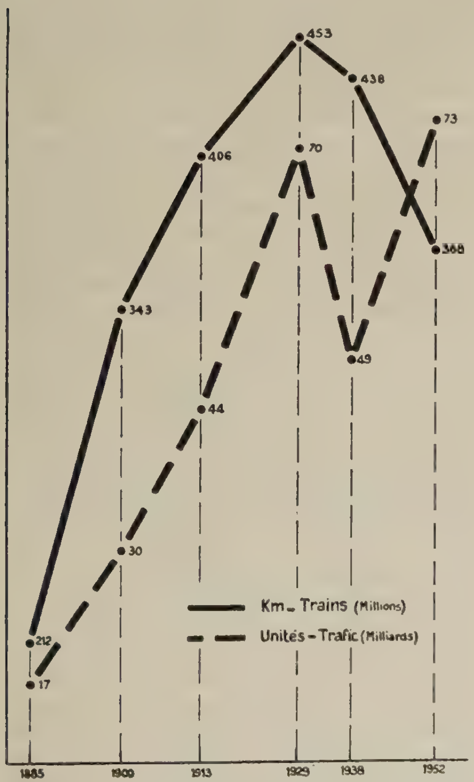
To keep pace with the traffic, the old Companies were always having to increase their train mileage and their main preoccupation was to intensify the services, strengthening their lines and calling upon every available resource of their system to deal with the traffic in transit.

After 1930, railway traffic suddenly began to fall off, and the train-kilometres progressively decreased (in spite of the increased passenger services which were introduced to try and maintain the corresponding receipts). But technical progress continued, especially in the case of traction and rolling stock; though hidden to some extent by the inevitable upsets due to the decline in the

traffic, they were fully exploited by the S.N.C.F. after the end of the war; for this reason, as the graph below clearly shows, a traffic greater than that of 1929 could be dealt with in 1952 by a train-mileage some 20 % lower.

Consequently, since the average number of services progressively decreased after 1930, the goad « economy » took over from the goad « the traffic », and the traffic in transit was transferred from the less economical double or single lines to the most favourable routes, i.e. the main lines with an easy profile or electric traction.

This diversion was moreover facilitated by the extension of modern equipment



Comparative graph showing the train mileage and traffic units.

——— km- Trains (millions)
— —— Units of traffic (thousand millions)

capable of increasing the traffic capacity of the main lines, i.e. in particular the development of electrification, the automatic block and train regulation; finally it was considerably accentuated on the S.N.C.F. which systematically revised the conditions under which interregional traffic was sent forward, eliminating competitive routes, such as Paris to Bordeaux via Saumur on the former State Railway, or by adopting the more economical routes such as Toulouse to Lyons via Nimes, Brittany to Lyons via Paris, Paris to Vichy via Vierzon, etc.

The measures of economy introduced since the Liberation : such as the adaptation of the passenger services, the reorganisation of the marshalling yards to facilitate the formation of freight trains having a full load, adjustment of the rates to favour a better user of the stock, have also greatly contributed to reducing the train mileage and favoured still more the concentration of traffic in transit on the main lines.

To sum up, technical progress and attempts at reorganisation during the last few years have naturally led to a real *internal co-ordination* of railway transport, and this co-ordination has been at the expense of the least economic routes.

This explains to a large extent why the traffic has dried up on many lines where nowadays only local trains are run.

***

But, it will be argued, though admittedly under present conditions these lines only have to deal with a small traffic, is it prudent to change them into single lines? Is there not a risk that such a step would be regretted in the future if railway traffic picked up once again like before 1930?

It would certainly be desirable, on the economic plane, if the railway could count upon any large increase in traffic; this would be one of the best possible things that could happen for its financial equilibrium.

Unfortunately, we cannot be very optimistic about such a prospect; it is very unlikely

that there will be any increase in the passenger traffic, if we look at the position in the United States which in many fields prefigures the probable economic evolution in Europe; the development of transport by helicopters also may seriously affect railway passenger transport over average distances.

As for the freight traffic, its development is closely bound up with the expansion of the national economy; the objectives of the Monnet plan are very far from being realised, and even if the traffic picked up again at its former rate of progress, it is to be feared that the railway would only get a very small part of the increase owing to the development given to the other methods of transport (canals, motor roads, high tension electric lines, pipe-lines) not to speak of the perspectives opened by the industrial use of atomic power.

Yet the technical progress achieved by the railway has greatly increased its traffic capacity. The record traffic of 1952 (73 thousand million traffic units, i.e. more than 40 thousand million TKU Freight) was easily absorbed, and the technical experts are agreed that, with some reservations as regards the rolling stock, the S.N.C.F. is in a position to deal with an increase of 70 to 80 % in the freight traffic (see the note by Mr. HUTTER on the economic theory of the railway published in the October 1952 *Revue Générale.)*

To sum up, railway productivity is greatly in excess of the national productivity : railway installations show a considerable margin over present day requirements, and the probability that this margin will ever be called upon (even after several decades) is extremely feeble; there is therefore little risk that we are doing the wrong thing in removing one of the lines on double lines with little traffic.

Moreover, the bed of the taken up line will remain, and if, contrary to expectations that now seem reasonable, it should be necessary to restore some of these double tracks in the future, it will not cost much more to reconvert them to double than to carry out the renewal work that would by then have been necessary.

VARIOUS FACTORS IN THE BALANCE SHEET FOR CONVERTING SECONDARY LINES TO SINGLE LINES.

Maintenance economies.

The change from double to single line does not make much difference to the bed in its widest sense : the banks, ditches, and fences remaining as they were, and the corresponding maintenance costs showing no change; the same applies to the bridges over the line as well as masonry bridges under the lines; only metal bridges with separate decks for each line can be simplified, and consequently maintenance costs saved; nor can anything be done as a rule to the level crossings, since the regulations about keepers cannot be modified, and the only benefit is the elimination of the risk of two trains passing at the same time for pedestrians and road vehicles at level crossings without keepers, where there are no gates or only automatic half-gates.

Regarding the maintenance of the permanent way, the carrying out of the work may involve more interruptions or time lost owing to the greater number of trains on the single line remaining; these inconveniences are largely made up by the possibility of using the space left by the line that has been removed for high capacity mechanical equipment, as well as the great flexibility given by the single line working which makes it possible to assure the safety of the working sites and their trolleys, as well as the safety of the service trains and trolleys over the route of the work from the stations.

The greatest economy is however due to the substantial reduction in the actual maintenance operations. As regards the permanent way material, it can be stated that the wear of the two rails that remain is not greater than the total wear of the four rails formerly, since the kilometric tonnage is the same. On the other hand, all the alterations of the rail fastenings to the sleepers and to the latter, which are a function of time and not of the tonnage are divided by two. Finally the saving in staff is of the

same order as the saving in the replacement and repair of material.

The result is that the saving in maintenance due to changing over to single track is practically half the cost of maintaining the double line.

In the case of secondary lines, this annual saving is on the average, at 1952 costs, about 500 000 francs per km of line, but obviously varies with the importance and kind of traffic, and oscillates, according to circumstances, between 200 000 francs and 700 000 francs. These figures include both maintenance savings and renewal charges; when only the actual maintenance is taken into account, they fall to the still appreciable average of 330 000 francs per km of line, the savings varying, according to circumstances from 135 000 to 480 000 francs.

Repercussions on the working.

Though the change over to single line is always beneficial for the busy maintenance department, it increases on the contrary the difficulties of the other Departments, owing to the difficulties of single line working; the operating programme (timetables, locomotive and staff hours, etc.) must take into account the train crossings; and above all the carrying out of the service and the steps to be taken when the trains run late are often upset by the effects of traffic in one direction upon traffic in the other.

The difficulties are not confined to the traffic and also occur in the field of safety, owing to the special risk there is with single line working of two trains running in opposite directions both being allowed onto the same section; this means that there must be very strict supervision of the carrying out of the services, in order to make sure that the regulations are strictly adhered to, the professional skill and good discipline of the operating and traction staff being one of the chief factors as regards safety of working for single lines.

However, the prejudice of the Operating Department to single line working has been progressively overcome by the introduction of modern equipment; there is nothing in common between the old methods when the stations had nothing but the train staff, then bells or telegraph, and modern practice where full use is made of the telephone to assure permanent contact between the stations, and on the more important lines the whole of the service is co-ordinated by traffic regulation.

The signalling and station equipment have also evolved, so that there is now greater flexibility as well as greater safety in effecting crossing operations.

But the most important step forward as regards safety lines is the extension of the single line block by means of pedals, which in practice eliminate the risk of any mistake on the part of the station staff and consequently make it possible to increase the traffic on certain single lines to the utmost practical limit admissible from the traffic point of view.

It is interesting to stress the results which have been obtained in this order of ideas, as many railwaymen fail to realise the true possibilities of single line working.

In France, the two most heavily loaded lines are those from Aix to Annecy (40 km = 24 miles) and Toulouse to Tessionnières (58 km = 36 miles) both of which at peak periods, deal with a daily traffic of 55 trains, the former only being open to traffic for 20 hours of the day. Such traffic has been exceeded on certain European railways; there is for example a daily output of 70 trains on the Gemunden to Waigolshausen line (46 km = 28 miles) on the German Bundesbahn and 60 trains on the Swiss Rupperswil-Goldau line (57 km = 35 miles).

An output of 60 trains has also been achieved in Italy between Naples and Calabra, and this is all the more remarkable as this line is 400 km (250 miles) long.

It should be made clear however that the above mentioned lines are lines through hilly country, where it would be extremely costly to have double lines, so that the various Departments have to be content with single lines and make the best possible use of them, involving high annual operating costs.

The position is quite different in the case of double lines which are being converted to single lines, since the bed is already there, so it would be going too far to think that all double lines with less than the above quoted traffic could be converted to single lines, as we must repeat these are noteworthy performances which cost the Operating a lot.

We have merely quoted these examples to show that the output obtainable is no obstacle to conversion to single track, which in sum depends on an estimate of the drawbacks and additional cost involved in working the services.

In the most usual case of secondary lines with little traffic, it can be considered that the difficulties are not great and mean above all a reduction in the flexibility of working.

But when the average traffic is considerable, more than 25 trains daily for example, the inconvenience to the operating becomes more marked and harder to put up with; these drawbacks are a function of the traffic characteristics as well as the length of line concerned.

It is not always possible to translate them into figures, as it is always difficult in the case of such a complex undertaking as a railway to isolate any given line or section of line in order to determine its economic factors; but it is obvious that the difficulties and additional costs involved in single line working increase very quickly as the traffic is the greater, and a limit is very soon reached beyond which single line working cannot be considered as of value for the general economy of the system.

The cost of conversion.

The cost of converting double track to single track depends directly upon operating requirements as regard output (distance between stations and consequently the number of stations to be equipped), as well as from the point of view of flexibility and safety (station equipment, block installations).

From this point of view, the operating department of the S.N.C.F. have endeavoured to have various kinds of equipment for single track working graded according to requirements so as to be adaptable to the actual service requirements, being very simple on lines with very little traffic and more highly perfected on the other hand on the other lines.

This way of working, which now has the sanction of fairly long experience, will naturally be applied to all new single lines; the different grades of equipment are as follows :

Lines with very little traffic : less than 10 to 12 trains daily and no trains apart from local stopping trains :

— simplified signalling in the stations, merely consisting of fixed notices STATION which are not lit up;

— telephone sectionning.

Lines with little traffic : less than 20 trains daily, run over by through trains :

— stations with movable signals, in principle showing a disc and warning signal on each side (sometimes a disc only);

— telephone sectioning.

Lines with little or average traffic : about 20 or 30 trains daily, with a few through trains :

— stations equipped with standard S.N.C.F. signalling : disc and warning at station entry and semaphore on departure, and when justified, distant control of the entry points;

— single line manual block with pedals.

To the cost of the signalling equipment must be added the cost of altering the crossing stations as well as the crossings that have to be made between stations owing to the suppression of the redundant line, and such supplementary alterations as the adaptation of the warning notices for level crossings, etc.

Balance sheet for secondary lines with little traffic.

The balance sheets, however, generally show a substantial credit corresponding to the value of the materials taken up (rails,

sleepers), which is very variable since it depends on their state of wear and consequently on the age of the line that is being taken up. This value, in the case of a line of average age amounts to about 500 000 francs per km.

Referring to double lines with little traffic (where, as we have seen, there is no additional operating cost to be recorded), in the most usual case where the stations are about 10 km (6 miles) apart we get the results shown in the following table (1), based on the mileage of the line, and moreover of a merely indicative value, since they correspond to lines with average characteristics.

Kind of line		Lines with very little traffic	Lines with little traffic	Lines with not much traffic
Approximate scale of cost of alteration per km of line.	Stations	50 000 fr	500 000 fr	1 200 000 fr
	Permanent way	360 000 fr	360 000 fr	360 000 fr
	Salvage of materials .	— 560 000 f	— 560 000 f	— 560 000 fr
	TOTAL. .	— 150 000 fr	300 000 fr	1 000 000 fr
Approximate **annual saving on maintenance** per km of line (including renewal)		300 000 fr	500 000 fr	700 000 fr

An examination of this table, based on the prices ruling in 1952, shows that the conversion of secondary lines with little traffic to single lines is usually a very profitable operation, as there is generally a credit balance, and in the other cases, the cost of conversion is paid off in a very short period.

(1) All the figures given here correspond to net savings or costs; they do not include the application of the addition of the 10th July 1952 to the Convention of the 31st August 1937, which lays to the charge of the State part of the maintenance costs of the superstructure of the S.N.C.F. installations, a proportion which was originally fixed at 60 % and progressively reduced to about 40 %.

THE CONVERSION PROGRAMME

Having reviewed the various general considerations relating to the operation of conversion, we will now give some details about the programme drawn up by the S.N.C.F. This is :

— on the one hand, the reconstruction programme which was drawn up in 1951 which has finally decided upon the retention of most of the lines converted to single track during the war or during the first reconstruction period;

— and on the other hand, the reorganisation programmes drawn up in 1952 and 1953, which provided for the conversion of double secondary lines with little traffic to single lines immediately.

The reconstruction programme.

The shortage of raw materials which was the direct consequence of the war made it necessary to take up lines or convert them to single track in order to salvage rails and sleepers, stocks of which were completely exhausted.

Many double lines were converted to single in this way :

— either to meet the rquirements of the Metropole or French Union (construction of the Sahara Railway);

— or forcibly to meet the demands of the army of occupation;

— or finally, at the beginning of reconstruction, to obtain immediately the material required to restore the more important centres or most vital arteries.

For these various reasons, 3 100 km (1 926 miles) of double line were converted to single, but these operations luckily could in most cases be applied to secondary lines, and unavoidable restoration to double track before 1951 only affected about 250 km (155 miles) of lines.

Taking into account certain additional reconstruction work which may be found necessary in the future, the S.N.C.F. finally estimated, in drawing up the programme for the completion of reconstruction work, that it was reasonable to definitely give up the idea of restoring more than 2 900 km (1 800 miles) of lines to double track, it being understood that some of these lines should be equipped with additional safety equipment, signalling and automatic block, justified by the importance of the traffic, as part of the reconstruction programme.

This reduction made by the S.N.C.F. in the reconstruction programme, at 1952 costs, *meant a saving in the reconstruction costs of about 30 thousand million francs*, which is a very appreciable saving for the French State.

It should also be recognised that the S.N.C.F. benefited considerably by maintaining these single lines, since it no longer had to stand the maintenance costs of the lines that were not rebuilt; the annual saving in this respect in fact amounts to over a thousand million francs.

The reorganisation grogramme.

After putting the system into order in this way, when the curtailment of lines effected during or after the war was retained and made permanent, the S.N.C.F. undertook a systematic revision of its remaining double track secondary lines with little traffic, i.e. those lines whose daily output had in principle fallen below 25 trains a day, and on which the change over to single track would not appreciably increase operating costs.

With this object in view, the General Management, after a regional investigation, drew up programmes for converting to single track a total of 2 200 km (1 367 miles), allowing a total of 800 million francs for the cost of this changeover, from which an annual saving of 1 200 millions was expected, taking renewal costs into account.

The work to be carried out, since it would be paid for in under one year by the annual saving in maintenance costs alone, was debited to the « Operating ».

These programmes were submitted to the Ministry of Public Works, but the Higher Authorities did not wholly approve them; whilst considering them justified from the commercial point of view during times of peace, they considered that they might be prejudicial to the national economy in times of war; in such an eventuality, the transport currents may be profoundly changed, and it is moreover necessary to have a certain flexibility to be able to meet the consequences of air attack.

The S.N.C.F. was therefore not allowed to realise the whole of the programme in question (the authorisations given covered some 780 km [484 miles] of lines nearly all of which have already been converted to single track, as the map shows), but it goes without saying that it would not have been fair to make the railway stand the whole of the financial consequences of such a decision and the State had to take over the cost of maintaining the second track on those lines which had to remain double lines owing to considerations of national interest; this moreover is merely a concrete application of the clauses of the Specifications of the S.N.C.F. (Article 26).

Future perspectives.

The programme for converting secondary lines to single track which we have reported above constitutes a relatively easy form of pruning, and it is already to be expected that other operations of this nature may be found fruitful in the future.

The perspectives from this point of view are fairly diverse :

a) the limit of 25 trains daily which was fixed in the case of lines included in the reorganisation programme mentioned above, was chosen to assure great profitability, and in fact as we have seen, the balance sheet as a whole gives a very short repayment period, less than one year.

But it is obvious that this altogether arbitrary limit need not be respected, and there are certain lines with slightly more traffic where, provided a certain additional operating expenditure is admitted, single line working would be financially interesting.

The decision arrived at should be subordinated to a thorough examination in the case of each line, taking into account the cost of the changeover and setting the extra operating difficulties against the maintenance savings, in so far as these can be equated.

It should also be remembered that in the balance sheet for converting to single line, the value of the material recovered is an item on the credit side, the value of which varies considerably according to the materials used on the redundant line.

If such material is immediately reusable, its value will often cover the whole cost of the changeover, and it would be advantageous to carry out the work at once without delay, so long as the additional operating costs involved remain lower than the saving in maintenance.

Similarly, the value of converting to single track is greatly increased as soon as it becomes necessary to renew one or other of the lines, since the considerable sums involved in renewing a line will thereby be avoided; expenditure under this heading may amount to as much as 500 million francs in the case of a line 70 km (43 miles) long which has to be completely renewed.

b) conversion to single track within the traffic limits now decided upon are in most cases the result of technical progress and the reorganisation of transport previously carried out.

Such technical progress, however, has not yet reached its final limit, nor have all the possibilities of recently designed equipment been exhausted; moreover the electrification programmes which the S.N.C.F. is now carrying out in agreement with the Ministry of National Economy will encourage further efforts to concentrate the traffic at the expense of the least favourable lines, and those lines deprived of their traffic in transit will in turn fall into the category of secondary lines which might be operated as single track.

c) finally, the conversion of certain lines might be considered to facilitate the reinforcement of bridges or other modernisation work that is desirable but would cost too much if double track were retained.

Reinforcement of bridges can be justified :

— either by the possible use on certain lines of more powerful locomotives, which are therefore heavier, in order to increase the weight of the trains;

— or by using heavier wagons on certain routes, 20 t. per axle which are of particular value as regards transport economy.

As for modernisation, this may concern electrification at 25 000 V which has made it possible to consider electrifying lines with a lower traffic rating; in particular it is probable that certain lines with average traffic within or close to a complex system of electrified lines might now be included provided they were first of all converted to single track, as this would reduce the cost of the overhead lines.

Conversion to single track would, moreover, be facilitated by the advantages attendant on electrification as regards running the services from the point of view of regularity, flexibility, and even in certain cases, fewer trains.

Consequently, certain combined electrification and conversion to single track programmes will probably be carried out which will be particularly profitable for the service as a whole.

The indications given above regarding future prospects are not mere ideas; concrete proposals have already been studied and have shown the indisputable value of

converting to single track certain secondary double lines with average traffic within the framework of the present traffic. Supplementary conversion programmes which may be carried out in the near future, within the next fifteen years for example, might affect some 1 000 to 2 000 km (620 to 1 240 miles).

We regret that we are not able to give any concrete examples at the present time, but the *Revue Générale des Chemins de fer* will keep its readers informed of any decisions taken as soon as these have been approved by the Higher Authorities.

CONCLUSIONS.

We have tried to report objectively the various aspects of conversion to single track, and we think that we have made it clear that these are the logical result of recent progress in the technique and organisation of railway transport; it would moreover have been surprising had such progress been limited to the well known reduction in the stock of locomotives and wagons, and it is obvious that using less traction and rolling stock, the railway would naturally have been led to use less lines on which to run the remainder.

Short of completely closing down lines, which cannot fail to have serious drawbacks, the only technical means that can be widely applied in reducing the extent of lines over which trains can run is to give up double track working in the case of the less heavily loaded lines and change over to single line working, the latter now offering much greater possibilities than formerly due to the flexibility of the new arrangements and the introduction of modern signalling equipment.

Conversion to single track means a reduction in equipment which makes it possible to lower the general cost of railway operation. The programmes already completed or in hand will give a total annual saving of more than two thousand million francs; in addition further conversions of secondary lines to single track can be considered for the future and these, combined in certain cases with the modernisation of the equipment, will be highly productive operations.

From this point of view, the policy followed by the S.N.C.F. marks an important step forward; it is a realistic policy which far from weakening them will increase their vitality by reducing their financial burdens, and consequently increase their potential capacity to compete against other methods of transport.

[313 .385 (73) & 656 .2 (73)]

A review of 1954 Railway Operations,(*)

by J. Elmer Monroe,

Vice-President and Director, Bureau of Railway Economics, Association of American Railroads.

(*Railway Age*, January 10, 1955.)

Economic trends in the United States in 1954 followed closely the pattern predicted by most forecasters at the year's beginning.

As anticipated, industrial production declined moderately below the record performance of the preceding year, down by 6 or 7 %. Business expenditures for new plant and equipment were off in similar moderate degree. Corporate profits after taxes decreased by approximately 11 % in the first three quarters of 1954, but that rate of decrease may have been lessened by improved business conditions in the final quarter of the year. Economic trend lines held remarkably firm throughout 1954, with an encouraging upward tilt developing in the late months as a result of increased activity in the durable goods industries.

Railroads in 1954 experienced much more severe declines in the level of their operations and in their net earnings than did most other industries. Freight carloadings declined 12 % below 1953 and were less than for any year since 1938, a year of severe economic depression in the United States. Earnings for the year were down about 25 % in the case of net railway operating income and about 30 % in the case of net income. Gross capital expenditures for additions and betterments to railway properties were cut by 35 % below 1953.

Why the decline ?

Others factors, as well as declining traffic, contributed to the unfavorable financial results of the year's operations. Wage rates averaged 5 cents per hour higher in 1954 than in the preceding year. Even so, the full effect of the settlement in August with the non-operating employees will not be reflected in expense accounts until 1955. Other demands of certain employee organizations were in negotiation at the year's end.

On the legislative front, two bills unfavorable to the railroads were enacted. The first of these authorized United States participation in construction of the St. Lawrence Seaway, which will add part-time facilities of transport in an already overcrowded field. The second enactment increased the amount of railroad employee earnings subject to payroll taxes from $ 300 to $ 350 per month and increased the benefits payable under the Railroad Retirement and Railroad Unemployment Insurance Acts. Finally, the serious competitive conditions with which the railroads have been faced for a number of years increased in intensity in 1954.

Better prospects for next year.

Notwithstanding the loss of approximately $ 1.3 billion in operating revenues as compared with the preceding year, the railroads were able through rigid expense control measures to hold the reduction in net earnings after taxes to about $ 275 million. While the railroads can ill afford to lose that amount of annual earnings, a loss which brought their rate of return for the year down to about 3 % on the net invest-

(*) Charts by Ralph M. Schmidl.

ment in their properties, it was as satisfactory a showing as could be expected under prevailing conditions. It demonstrated the inherent strength and soundness of the industry, operated as it is under severe regulatory and competitive handicaps.

A favorable development for the railroads in 1954 was the encouraging upturn in economic trends toward the year's end. At this time a year ago considerable uncertainty existed as to how far the then- existing down trends would go. Now the question is how far into the future the present upturn may extend. Present indications are that economic conditions in 1955 will improve moderately over 1954, and if so, the railroads will benefit.

There were some indications in 1954 that the railroads' competitive position may be improved. The movement of truck trailers on rail flat cars, often referred to as « piggyback » or « TOFC », gained considerable momentum during the year. While there are many difficult problems still to be worked out before this new development can achieve important stature in the intercity transportation of freight, it has possibilities which are receiving thorough exploration.

Another development was the appointment by the President of a Cabinet Committee on Transport Policy and Organization. Inconsistent government policies and programs concerning transportation have long needed review and re-evaluation. The President's committee is charged with that duty and it is hoped that its report will lead to the establishment of more equitable conditions in the broad transportation field, to the particular benefit of the railroads.

Traffic trends unfavorable in 1954.

Statistical entries appearing in this review relate to line-haul railways of Class I and were obtained from reports of the Interstate Commerce Commission or tabulations of the Association of American Railroads. For the most part, the statistics cover operations in the first 9 or 10 months of 1954, with comparable figures for corresponding periods of preceding years. However, in the case of certain key items, such as traffic volumes and net earnings, estimates for the full year 1954 are given.

Table 1 shows comparative statistics of freight and passenger traffic handled in each of the past ten years, 1945 to 1954, the entries for 1954 being approximations for the full year. Charts 1 and 2 depict in graphic form the annual fluctuations in these figures.

TABLE 1. — **Comparative traffic summary.**

Year	Revenue carloadings (thousands)	Revenue ton-miles (millions)	Revenue passenger-miles (millions)
1954	33 863	545 000 *	29 400 *
1953	38 303	605 813	31 655
1952	37 985	614 754	34 010
1951	40 499	646 620	34 614
1950	38 903	588 578	31 760
1949	35 911	526 500	35 095
1948	42 719	637 917	41 179
1947	44 502	654 728	45 921
1946	41 341	591 982	64 673
1945	41 918	681 001	91 717
1945-1954			

* Partially estimated.

TABLE 2. — **Carloadings by commodity groups — 1954 vs. 1953**

Commodity group	1954 (000)	Increase (I) or Decrease (D) compared with 1953	
		Number (000)	Per cent
Grain	2 548	I 90	I 3.6
Livestock	447	D 5	D 1.0
Forest products	2 078	D 182	D 8.0
Merchandise, LCL	3 196	D 307	D 8.8
Miscellaneous	17 407	D 2 000	D 10.3
Coal	5 650	D 732	D 11.5
Ore	2 115	D 1 031	D 32.8
Coke	422	D 271	D 39.1
Total	33 863	D 4 438	D 11.6

Carloadings of revenue freight in the 52 weeks of 1954 totaled 33 862 883 cars, a decrease of 4 438 262 cars under 1953, or 11.6 %. Loadings for 1954 were the lowest experienced in the postwar period and, in fact, in any year since 1938, being about 10 600 000 cars, or 24 %, under the peak postwar year of 1947.

Seven of the eight commodity groups showed declines in loadings in 1954 below 1953. Greatest relative losses during the year were recorded in coke (down 39 %) and in ore (off nearly 33 %). The two largest commodity classes, miscellaneous (mostly manufactured goods) and coal, which together account for more than two-thirds of total loadings, were off 10 % and 11 %, respectively. Loadings of forest products and less-carload freight were down between 8 and 9 %. Livestock loadings declined about 1 %. Grain and grain products was the only commodity group to show an increase, up more than 3 %.

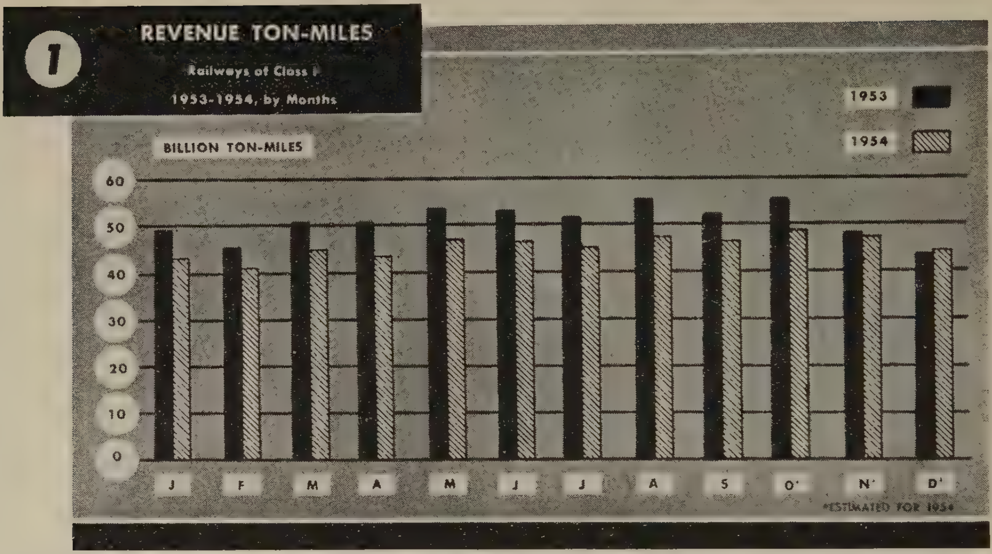
Carloadings by commodity groups in 1954, together with absolute and relative changes from 1953, are shown in Table 2.

Ton-miles. Measured in terms of revenue ton-miles, weight of lading times distance hauled, freight traffic in 1954 approximated 545 billion. This was a decrease of about 60 billion ton-miles under 1953, or 10 %. The volume of freight traffic in 1954 thus measured was less than in any postwar year except 1949, when declining business activity and prolonged strikes in the coal and steel industries seriously affected railroad traffic.

Chart 1 shows the monthly trends in ton-miles during the years 1953 and 1954. The ton-miles handled during the several months of 1954 fell below those of 1953 in each month, except possibly in December.

Passenger - miles. Revenue passenger-miles in 1954 aggregated 29.4 billion, about 7 % under 1953. This was the smallest volume of passenger traffic recorded for any year since 1941, when passenger-miles likewise totaled 29.4 billion. The present volume of railroad passenger traffic is less than one-third what it was in the two wartime years 1944 and 1945, and is less than half the level which prevailed in 1946, the first postwar year.

Chart 2 shows the trends by months in passenger-miles during the past two years, each month of 1954 being below the corresponding month of 1953.



Financial results of 1954 operations.

Railroad revenues, expenses, and net earnings all decreased in 1954. Both actually and relatively, the decrease in revenues was greater than the reduction in expenses, with the result that net earnings declined sharply.

For the year 1954 as a whole, operating revenues approximated $ 9.4 billion (down $ 1.3 billion), operating expenses were about $ 7.4 billion (down $ 700 million), net railway operating income stood at about $ 835 million (off $ 275 million), and net income approximated $ 610 million (off $ 260 million). The rate of return earned on net property investment averaged a fraction more than 3 % for the year.

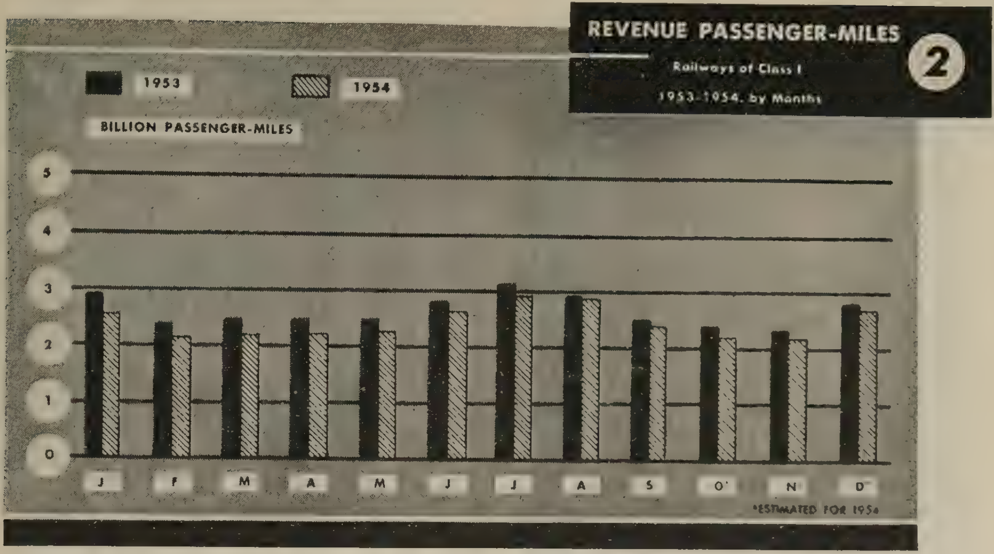
Excluding income tax deferrals resulting from accelerated amortization of defense projects (about $ 180 million in 1954 compared with $ 146 million in 1953) the rate of return earned in 1954 was only about 2.45 %.

Table 3 shows a condensed income

TABLE 3. — **Condensed income account — Ten months, 1952-1954**

	1954 (millions)	1953 (millions)	1952 (millions)
Total operating revenues . . .	$ 7 780	$ 9 017	$ 8 739
Total operating expenses . . .	6 159	6 781	6 681
Operating ratio (per cent) . .	79.16	75.21	76.45
Taxes	740	1 086	1 048
Net railway operating income.	671	953	857
Rate earned (per cent) * . . .	3.10	4.45	4.14
Net income after charges . . .	472	739	631

* Based on 12 months ended October 31.



account for the first ten months of 1954 with comparable statistics for the corresponding periods of 1953 and 1952. The final months of 1954 made a better relative showing than did the earlier months of the year.

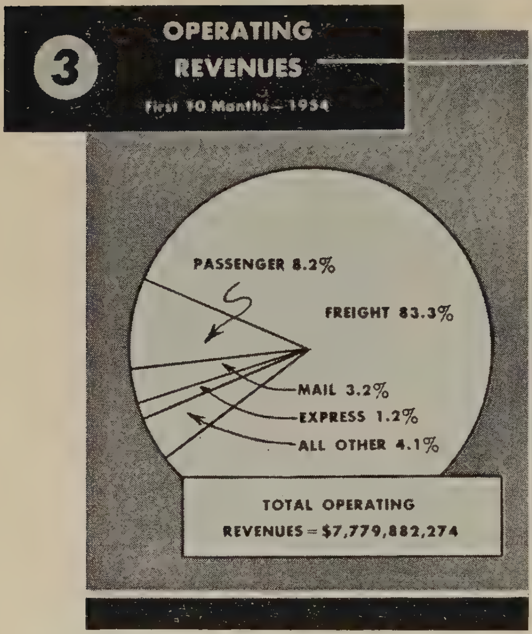
Operating revenues for the first ten months of 1954 decreased 13.7 % below the same period of 1953, while operating expenses were reduced 9.2 %. In dollars, the reduction in expenses (a little more than $ 600 million) was only about half as much as the decrease in revenues (about $ 1 200 million). The operating ratio (the percentage which operating expenses bears to operating revenues) thus rose from 75 % in 1953 to 79 % in the 1954 period.

Taxes in the ten-month period of 1954 decreased $ 346 million, or by 31.8 %. Federal income taxes accounted for the greater part of this reduction, declining by $ 324 million, or 60.3 %, as a result of reduced net earnings. Payroll taxes decreased $ 19 million, or 7.7 %, reflecting (1) the reduction in railroad employment brought about by lesser traffic, and (2) a partial offset thereto resulting from amendments to the Railroad Retirement Tax Act increasing the amount of monthly taxable employee earnings.

Net railway operating income for the ten-month period decreased $ 281 million, or by 29.5 %. This means that the sum of reductions in operating expenses, taxes and net rentals failed by that amount to equal the decrease in operating revenues. Net income after charges for the ten-month period of 1954 was $ 267 million, or 36.1 %, below the corresponding period of 1953.

For the 12-month period ended October 31, 1954, the rate of return earned on property investment (after depreciation) was 3.10 %, compared with 4.19 % for the calendar year 1953 and 4.16 % for the calendar year 1952.

Table 4 shows the five general operating revenue accounts for the first 10 months of the years 1954, 1953, and 1952. Each of these accounts declined substantially in 1954. Mail revenue in the 1954 period includes about $ 8 million of retroactive pay applicable to 1953. That amount accrued from the increase in mail pay rates of 10 % authorized by the Interstate Commerce Commission on March 15, 1954, but



retroactive to October 1, 1953. Taking that fact into consideration, mail revenue in the first 10 months of 1954 declined by about 6 %, reflecting further diversion from the railroads of general mail to trucks and of first-class mail to air transport.

The severe declines experienced in freight and passenger traffic volumes resulted in decreases of 14.7 % in freight revenue and of 9.2 % in passenger revenue. Express privilege payments received by the railroads from the Railway Express Agency dropped 14.2 %. All other revenues decreased 12.1 %.

Chart 3 shows in graphic form the sources of railroad operating revenues in the first ten months of 1954. Of total operating revenues received from transportation services performed in that period, 83.2 % was from the haulage of freight and 8.2 % from the transportation of passengers.

Table 5 summarizes railroad operating expenses by general accounts for the

TABLE 4. — **Operating revenues — Ten months, 1952-1954**

	1954 (millions)	1953 (millions)	1952 (millions)
Freight	$ 6 475	$ 7 588	$ 7 257
Passenger	641	706	757
Mail	250	250	256
Express	94	109	109
All other	320	364	360
Total	7 780	9 017	8 739

TABLE 5. — **Operating expenses — Ten months, 1952-1954**

	1954 (millions)	1953 (millions)	1952 (millions)
Maintenance of way	$ 1 134	$ 1 322	$ 1 268
Maintenance of equipment	1 450	1 652	1 620
Transportation	3 009	3 233	3 237
Traffic, general and other	566	574	556
Total	6 159	6 781	6 681

10-month periods of the past three years (see also Chart 4). Application of rigid control measures to operating expenses in 1954 was reflected in decreases in each of the principal expense accounts. Maintenance of way expenses declined 14.2 %; maintenance of equipment expenses were off 12.2 %; and transportation expenses decreased 6.9 %.

Table 6 shows for the ten-year period 1945 to 1954 the net railway operating income and rate of return earned on net property investment. Entries for 1954 represent estimates for the full year. Net railway operating income in 1954 fell below that for any other year in the period, except for the postwar transition years of 1946 and 1947, and the recession year of 1949. The net railway operating income earned in 1954 of $ 835 million was about $ 275 million, or 25 %, below that of 1953. Rate of return on net property investment was only 3.13 %, less than in any other year of the 10-year period except 1946 and 1949.

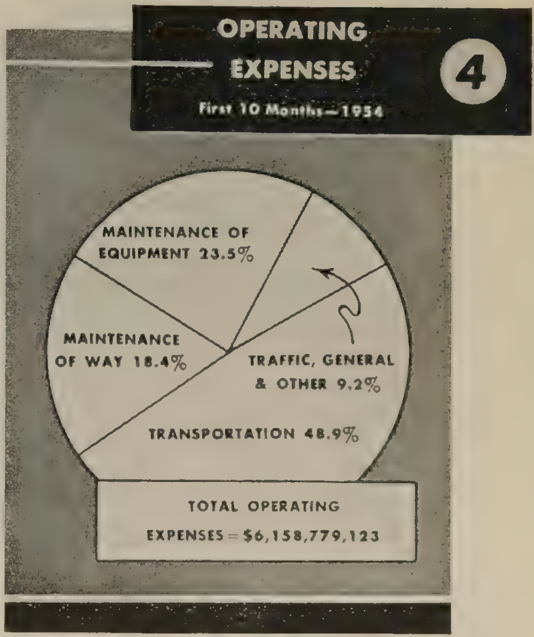


TABLE 6. — **Rate of return — 1945-1954**

Year	Net railway operating income (millions)	Rate of return on investment after depreciation
1954 (est.)	$ 835	3.13 %
1953	1 109	4.19
1952	1 078	4.16
1951	943	3.76
1950	1 040	4.28
1949	686	2.88
1948	1 002	4.31
1947	781	3.44
1946	620	2.75
1945	852	3.70

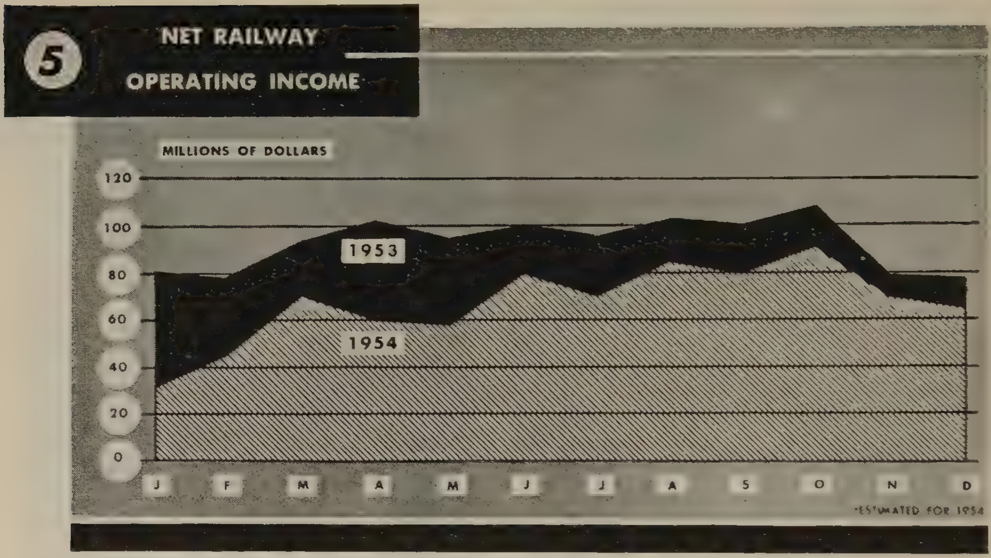
Chart 5 shows net railway operating income, by months, for 1953 and 1954, while Chart 6 shows the trend in annual rates of return earned on net investment, from 1945 to 1954.

Employment down but wage rates advanced.

Railroads paid their employees in 1954 approximately $ 4 850 million, about 9 % less than in 1953. The 1954 payroll was paid to an average of 1 062 000 employees, which was 144 000, or 12 %, fewer employees than in 1953. Annual earnings averaged $ 4 567 per employee in 1954, or 3.4 % more than the average of $ 4 415 in the preceding year. The 1954 average was 68 % higher than that of 1945, and about 2 1/3 times the prewar average in 1940.

The average straight time rate of pay of railroad employees stood at $ 1.94 per hour in 1954, or 2.6 % above that of the preceding year. It was more than twice as great as the 1945 rate and nearly two and two-thirds times the 1940 prewar rate.

Table 7 shows for the years 1940 and 1945 through 1954, the average number of railroad employees, total payroll, average annual earnings per employee, and average straight time rates and earnings per hour.



Virtually all railroad employee groups filed demands in 1953 for wage increases, rules changes and/or fringe benefits of one kind or another. With one exception, settlement of these demands carried over into 1954.

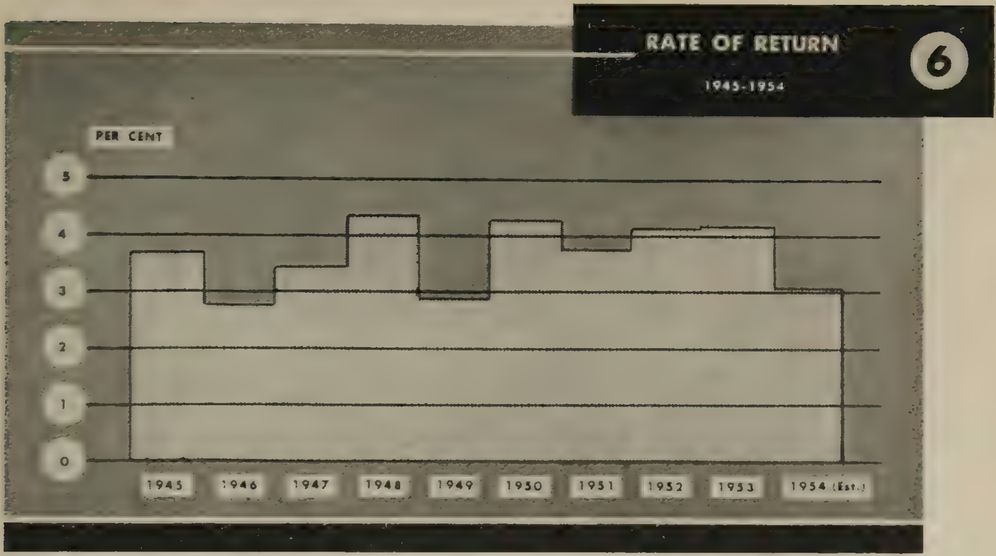
Settlement with trainmen. Agreements with the trainmen was reached near the end of 1953, affecting about 25 % of road conductors and the majority of road trainmen, yard conductors and yard brakemen. Under the agreement, the cost-of-living

TABLE 7. — **Employees and their compensation**

Year	Average number of employees	Total payroll (millions)	Average annual earning of employees	Average straight time hourly	
				Rate	Earnings
1954 (*)	1 062 000	$ 4 850	$ 4 567	$ 1.94	$ 2.04
1953	1 206 312	$ 5 326	$ 4 415	$ 1.89	$ 1.99
1952 (a)	1 226 663	$ 5 338	$ 4 352	$ 1.84	$ 1.94
1951 (a)	1 276 000	$ 5 336	$ 4 182	$ 1.76	$ 1.84
1950 (a)	1 220 784	$ 4 621	$ 3 785	$ 1.58	$ 1.65
1949	1 191 444	$ 4 419	$ 3 709	$ 1.44	$ 1.51
1948	1 326 906	$ 4 769	$ 3 594	$ 1.31	$ 1.37
1947	1 351 961	$ 4 350	$ 3 218	$ 1.17	$ 1.22
1946	1 358 838	$ 4 170	$ 3 069	$ 1.12	$ 1.16
1945	1 420 266	$ 3 860	$ 2 718	$ 0.93	$ 0.97
1940	1 026 956	$ 1 964	$ 1 913	$ 0.74	$ 0.77

(*) Estimated.

(a) Includes retroactive wage increases paid in subsequent years.



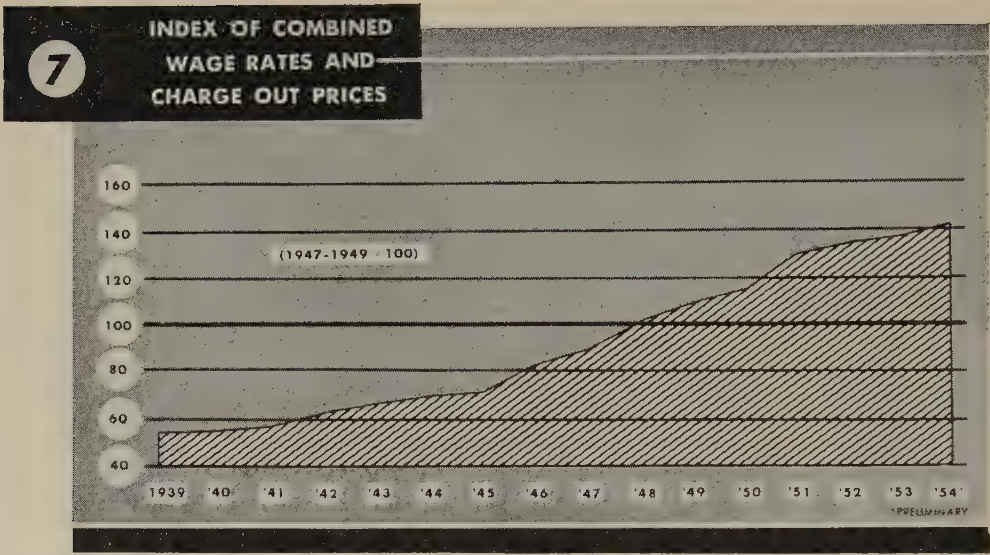
escalation clause, which had then been in effect for more than two years, was cancelled and the accumulated wage increases of 13 cents per hour under that clause were incorporated in basic rates of pay. The agreement also provided for a further increase in wage rates of 5 cents per hour, effective December 16, 1953, and, commencing with the year 1954, for an additional week's paid vacation (three weeks in all) for employees having 15 or more years of service.

Settlements with Firemen, Conductors and Switchmen. Following the December 1953 settlement with the Trainmen, similar agreements were entered into in 1954 with the Firemen, Conductors and Switchmen.

Engineers' arbitration. The Engineers declined to accept the pattern settlement agreed to by the other operating employees, insisting that their craft should receive a substantial percentage increase for the purpose of restoring « traditional wage relationships with the firemen ».

Under the auspices of the National Mediation Board, an agreement to arbitrate the dispute was signed on March 25, 1954. Arbitration proceedings opened in Chicago on April 26, and continued intermittently until July 30, 1954. The board rendered its award on August 13, 1954, denying entirely the claim of the Engineers for a differential percentage increase, and awarding in lieu thereof the pattern settlement of 5 cents per hour and a third week of vacation after 15 years of service, under the same terms and effective on the same date as had been agreed to by the other operating employees. Also, the cost-of-living escalation clause was cancelled and the then existing allowance of 13 cents per hour was incorporated in basic wage rates.

Conductors' graduated rates. At the request of the Conductors, the Mediation Board resumed mediation in Chicago on October 5, 1954, of a demand under which graduated rates of pay for all classes of service would be established based on weight on drivers of locomotives. Mediation was unsuccessful On November 23, 1954, the President of the United States created an « emergency board » to investigate and make recommendations in response to the Conductors' graduated rates dispute.



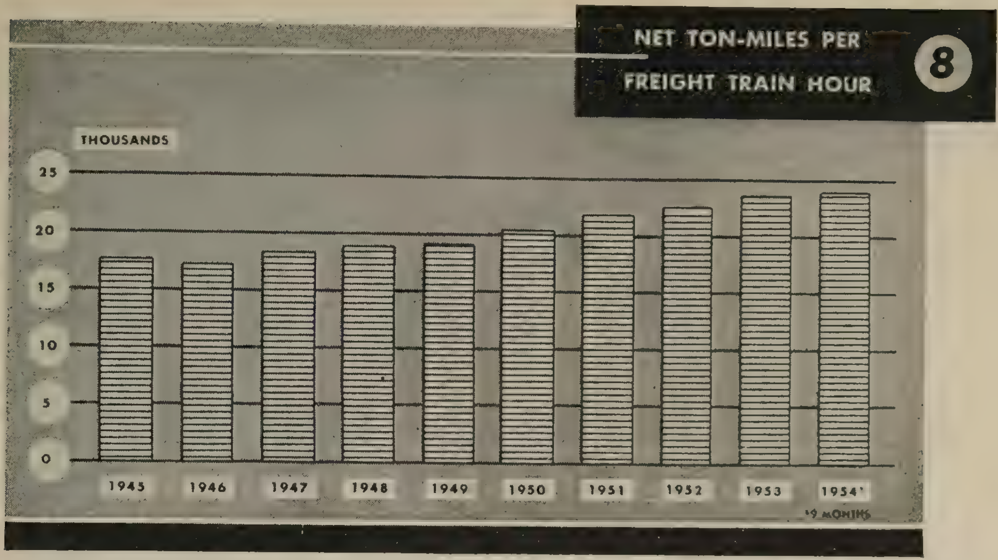
Hearings were not completed at the year end.

The Diesel arbitration. Hearings before an Arbitration Board, which began in Chicago on October 27, 1953, were concluded on March 16, 1954. The issue was whether or not the railroads were violating that section of the Diesel Agreements which provides that a fireman (helper) shall be in the cab at all times when a train is in motion in high-speed, streamlined, or mainline through passenger service, and further that if compliance with the foregoing requires the services of an additional man to perform the work customarily done by the fireman (helper), he shall be taken from the ranks of the Firemen.

The Arbitration Board rendered its award on April 13, 1954, in which it found no specific violation of the Firemen's Diesel Agreements. Among other things, the board found that firemen do not have the exclusive right to perform engineroom work. Maintainers, instructors and supervisory officers may perform operational duties incident to their work, but may not be assigned in lieu of a fireman. The carriers have the unrestricted right to determine when an additional employee shall be assigned to a multiple-unit Diesel locomotive. If an employee is assigned to perform work customarily performed by firemen, he shall be taken from the seniority ranks of firemen.

Of particular significance is the fact that the award included a definition of the so-called watching-rule trains (in high-speed, streamlined, or main-line through passenger service) under which the definition of such trains is much less restrictive upon management than the previous interpretation.

Non-operating Employees. Hearings before an emergency board in the Non-operating Employees' Rules and Fringe Benefits Case were concluded on April 3, 1954. The board issued its report on May 15 recommending (*a*) changes in vacation and holiday pay rules, (*b*) establishment of a health and welfare plan on a fifty-fifty contributory basis, and (*c*) acceptance of certain of the carrier rules proposals. Union demands for double-time pay for work performed on holidays were denied, as also was premium pay for



Sunday work as such. The board also recommended against liberalization of existing free transportation arrangements.

The recommendations of the emergency board were adopted by the parties in an agreement dated August 21, 1954. The agreement provides in general for a third week of paid vacation after 15 years of service; pay on seven national holidays for regularly assigned employees; and adoption in principle of a health and welfare plan. The agreement of August 21, 1954, included revision of certain working rules making them more favorable to the carrier.

By agreement dated December 3, the cost-of-living escalation clause contained in the agreement of March 1, 1951, was cancelled and the cumulated cost-of-living allowance of 13 cents per hour being paid under that agreement was included in the basic rates.

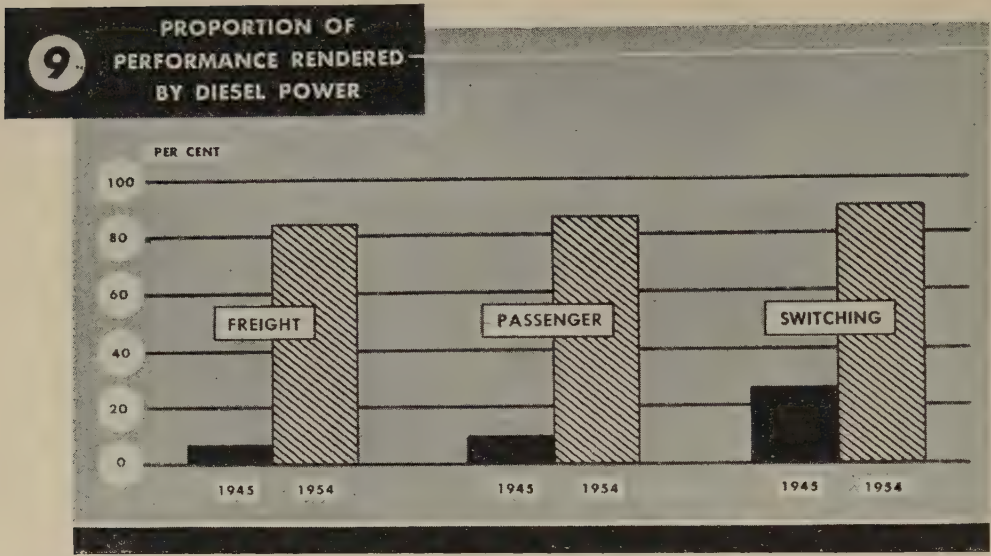
Demands served in 1954. In addition to the settlements consummated in 1954 and the unsettled disputes with the Conductors and Switchmen, a series of new demands were served during 1954 by certain of the operating organizations. At the end of the year these proposals were in various stages of negotiations and mediation.

On June 7, 1954, the Trainmen served proposals for wage increases which they claimed were to correct « inequities » resulting from the increased length of trains in road service, and « inequities » in the rates of pay of yardmen. In addition, paid holidays were proposed for road and yard men. In yard service it was proposed to increase the differential between conductors and brakemen by $ 1.15 per day and to establish shift differentials of 6 cents per hour on the second trick and 9 cents per hour on the third trick.

The Firemen's proposal, which was served on July 1, 1954, calls for the establishment of a minimum guarantee of $ 18.00 per day for firemen in road service and an increase of $ 2.24 per day in yard service.

On July 15, 1954, the Switchmen also requested an increase of $ 2.24 per day.

The Engineers, having indicated dissatisfaction with the pattern adjustment awarded them by the Arbitration Board, announced that they would serve proposals



for changes in pay and working rules on an individual road by road basis and that they proposed to handle such demands to conclusion on the individual roads rather than on a national basis. At the year's end the Engineers had served such demands on a few railroads.

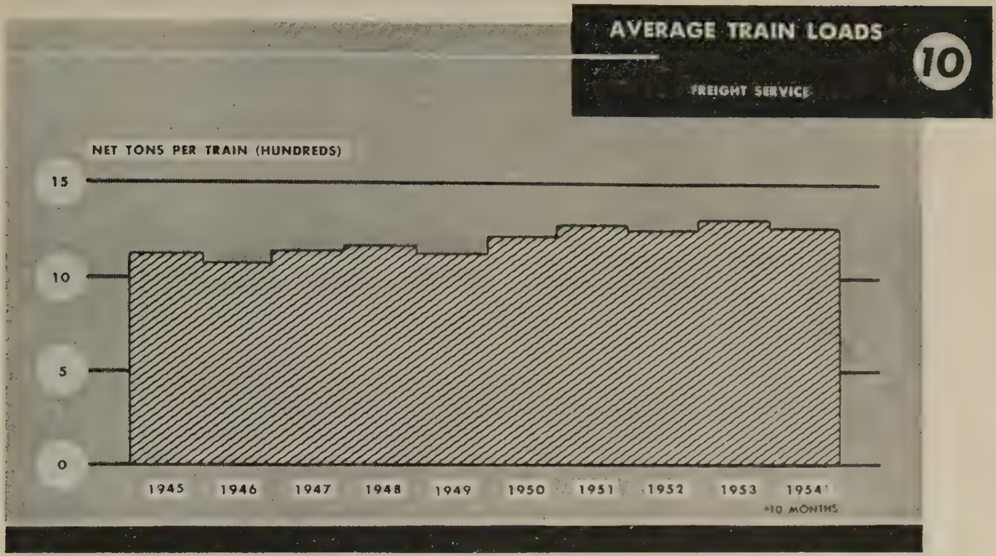
Material prices and wage rates.

Trend in average unit prices paid by the railroads for fuel, materials and supplies, for various dates from December 1939 through October 1954, are shown in Table 8. As there indicated, such prices in 1954 fluctuated within a narrow range, the all-material index in October being only one-tenth of one percentage point higher than in October 1953.

Between December 1939 and October 1954, the all-material price index rose from 52.6 to 123.9, or by 136 %. For fuel alone, the increase during the same period was 130 %, and for materials other than fuel the increase for the period was 139 %.

TABLE 8. — **Railway material price index** (mid-year 1947-1949 = 100).

Month	All materials including fuel	Materials and supplies (other than fuel)	Fuel (coal and oil)
October 1954	123.9	132.8	109.1
July 1954	122.9	131.2	109.1
April 1954	123.5	130.9	111.6
January 1954	124.1	131.4	112.4
October 1953	123.8	131.1	111.8
October 1952	118.5	126.3	105.9
December 1945	71.1	72.1	69.3
December 1939	52.6	55.5	47.5



The indexes in Table 8 show the trend in spot prices. A charge-out price index (reflecting original cost of materials consumed during the year) is shown in Table 9, as well as an index for wage rates, years 1939, 1945, and 1948 to 1954.

Data on the length of time materials and supplies are held in stock before being used are the bases for converting spot prices into charge-out prices.

Between 1939 and 1954, the charge-out index for material prices and wages combined (averaged 1947-1949 = 100) rose from 55.2 to 140.9, or by 155 %.

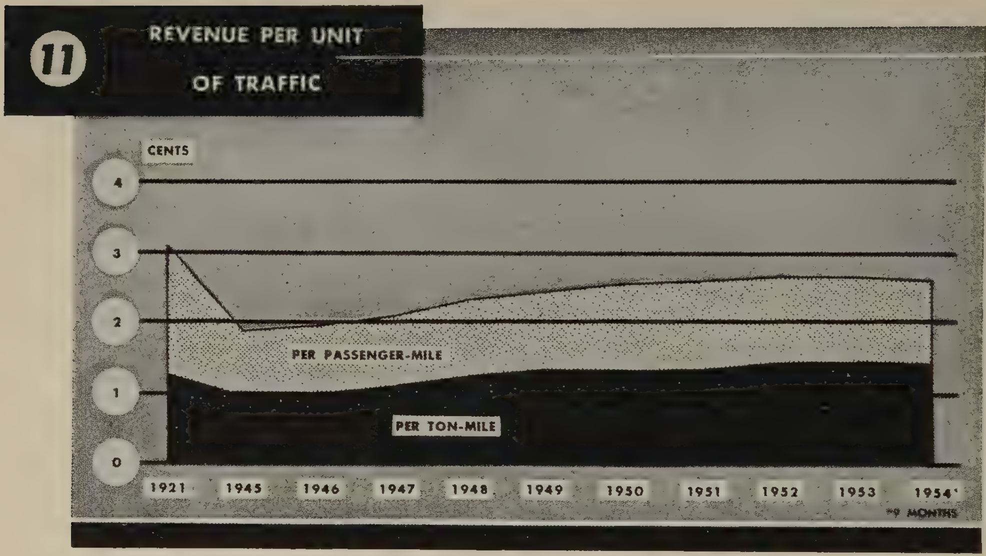
Chart 7 is a graphic representation of the rise since 1939, in the unit costs of labor and materials.

Average revenue per unit of traffic.

During the first nine months of 1954 revenue per ton-mile averaged 1.431 cents, while revenue per passenger-mile averaged

TABLE 9. — **Material prices and wage rates** — (Average 1947-1949 = 100).

Year	Charge-out prices for all materials including fuel	Wage rates (all employees)	Material prices and wage rates combined
1954 (est.)	124.2	148.1	140.9
1953	122.0	144.2	137.5
1952	119.1	140.8	134.3
1951	117.5	134.1	129.1
1950	105.7	120.5	116.1
1949	106.4	110.0	108.9
1948	104.7	100.2	101.6
1945	69.3	71.2	70.6
1939	52.0	56.5	55.2



2.614 cents. Table 10 shows these averages for each year from 1945 to 1953, and for the first nine months of 1954 (see also Chart 11).

TABLE 10. — **Revenue per unit of traffic 1945-1954**

Year	Per ton-mile (cents)	Per passenger-mile (cents)
1954 (9 months)	1.431	2.614
1953	1.478	2.658
1952	1.430	2.664
1951	1.336	2.601
1950	1.329	2.561
1949	1.339	2.452
1948	1.251	2.341
1947	1.076	2.097
1946	0.978	1.947
1945	0.959	1.871

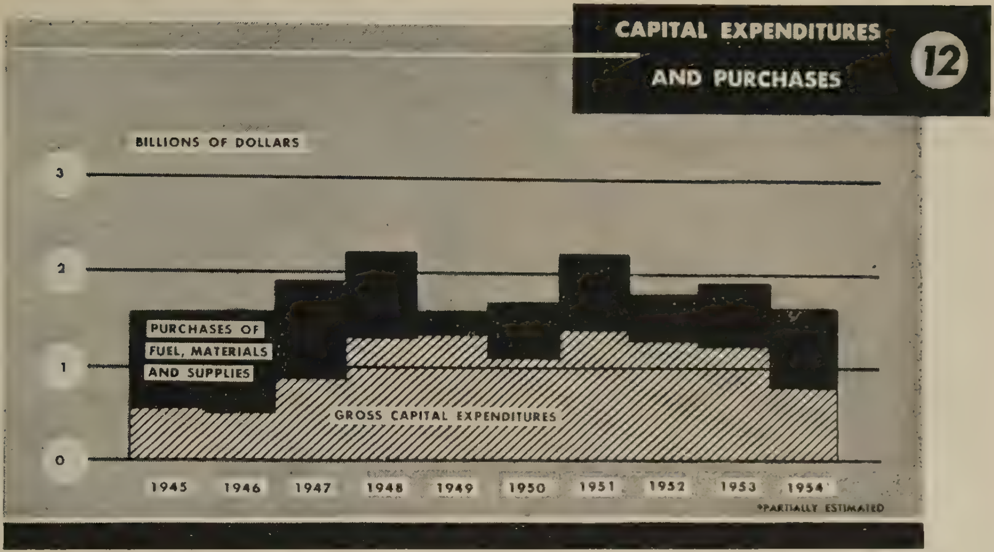
Revenue per ton-mile in the first nine months of 1954 declined about 3 % below the average for the year 1953, reflecting the composite effect of changes in traffic consists, in length of haul, and in rates.

Although there were some increases in communication fares, revenue per passenger-mile for the 1954 period was slightly lower (less than 2 %) than it was in the year 1953. A sharper decline in parlor and sleeping car traffic than in the lower-fare coach traffic was largely responsible for this situation.

Capital expenditures and purchases.

Table 11 shows gross capital expenditures made by Class I railways for additions and betterments to their properties, as well as the amounts expended for purchases of fuel, materials and supplies, years 1945 to 1954 (see also Chart 12). Entries for 1954 are estimated.

Capital expenditures in 1954 approximated $ 810 million, a reduction of about 35 % under the amount expended in 1953. This was a considerably smaller outlay for railroad capital improvements than in any of the preceding six years, when such expenditures exceeded one billion dollars in each year and exceeded one and one-quarter billion dollars in five of the six years.



During the nine postwar years, 1946 to 1954, railroad capital expenditures exceeded $ 9.9 billion, an average of $ 1.1 billion per year. Of this total, $ 6.9 billion, or nearly 70 %, was spent for equipment, and $ 3.0 billion was used for improvements to roadway and structures.

TABLE 11.

Capital expenditures and purchases 1945-1954

Year	Gross capital expenditures (thousands)	Purchases of fuel materials and supplies (thousands)
1954 (est.)	$ 810 000	$ 1 650 000
1953	1 259 794	1 920 481
1952	1 340 912	1 817 750
1951	1 413 995	2 175 859
1950	1 065 842	1 739 908
1949	1 312 200	1 641 406
1948	1 273 484	2 183 331
1947	864 689	1 909 209
1946	561 957	1 570 555
1945	562 980	1 572 404

Of the 1954 expenditures, about 62 % was allocated to equipment and the remaining 38 % was spent on roadway and structures. The fact that the railroads' dieselization program has passed its peak had considerable to do with the decline in 1954 in the proportion of equipment expenditures.

Purchases of fuel, materials and supplies declined sharply in 1954 to a total of about $ 1 650 million. This was a decrease of $ 270 million, or 14 % under 1953. The reduction reflects both the declining use of materials by the railroads in 1954 and reductions made during the year in the stocks of materials on hand.

Car and motive power trends.

The influence of declining traffic and reduced earnings in 1954 on locomotive and freight car ownership, on the number of new units installed, and on the unfilled orders at the year's end, is shown in Table 12. The drop in carloadings to the lowest level in 16 years largely removed the incentive to increase the freight car fleet at this time, and the shrinkage in net earnings made it undesirable for the

TABLE 12. — **Equipment ownership and installations** — Class I Railroads, 1948-1954.

Year	Ownership at end of year	Installed during year	On order and end of year
Steam locomotives:			
1954 (Dec. 1)	8 828	...	—
1953	11 696	15	—
1952	15 903	19	15
1951	21 200	18	19
1950	25 265	12	16
1949	28 809	57	13
1948	32 613	86	72
Diesel and electric locomotives (1):			
1954 (Dec. 1) (2)	17 595	807	264
1953	16 978	1 836	395
1952	15 322	2 396	817
1951	13 017	2 540	1 720
1950	10 531	2 384	1 628
1949	8 169	1 808	885
1948	6 368	1 401	1 561
Freight-carrying cars (3)			
1954 (Dec. 1)	1 738 505	26 706	13 639
1953	1 776 017	67 548	27 678
1952	1 756 700	63 748	67 138
1951	1 751 731	84 218	104 831
1950	1 717 659	39 872	109 174
1949	1 749 736	78 876	12 861
1948	1 754 840	96 204	84 161

(1) Complete locomotives as operated.
(2) Includes 25 gas turbine locomotives owned and 15 installed.
(3) Excludes railroad controlled private refrigerator car lines.

railroads to assume additional large obligations financing the purchase of new equipment units. Furthermore, deferral of taxes through accelerated amortization on new equipment became less attractive to railroads anticipating below normal taxable income in 1954.

Freight Cars. The freight car ownership expansion program inaugurated at the start of the Korean War in 1950 was temporarily shelved in 1954 as railroads reexamined their equipment requirements in the light of a lower level of economic activity and a further reduction in their share of intercity freight traffic. Only about 28 000 new freight cars were placed in service in 1954 by Class I railroads, the smallest annual total since 1939. The backlog of unfilled orders for new freight cars dropped steadily through most of the year.

The subnormal installation of new freight cars in 1954, coupled with a higher rate of retirements than had been experienced in three prior years, resulted in a loss of about 40 000 units in the total freight car ownership of the Class I railroads.

Due to the lesser demand for cars and the necessity for the railroads to trim their

maintenance expenditures, the serviceable freight car fleet dropped faster and farther than did ownership. Freight cars undergoing or awaiting repairs rose steadily from 87 637 cars on January 1, equivalent to 4.9 % of ownership, to 125 523 cars, or 7.2 % of ownership, on October 1. The percentage dropped to 6.9 on December 1, largely due to retirement of a large number of bad orders cars. The combined effect of decreased ownership and increased bad orders was a reduction during the year of approximately 75 000 in the number of serviceable freight cars.

Passengers Cars. Ownership of passenger train cars in 1954 continued the decline which began in 1946 and has continued in each postwar year, resulting in an overall loss of about 8 000 cars in the nine-year period. Railroad ownership of passenger train cars of steel or steel underframe construction on July 1, 1954, totaled 34 552 a decrease of 532 cars under the January 1 ownership and 718 less than the number owned on July 1, 1953. An additional 5 539 cars were operated by the Pullman Company, a decrease of 132 cars in the first six months of 1954 and a reduction of 688 cars below mid-year 1953.

There were 193 new passenger train cars installed in the first half of 1954, and 331 new cars were on order at the end of that period. In the corresponding period of 1953, 112 new cars were installed and 566 new cars remained on order.

Locomotives. As shown by Table 12, locomotive ownership, installations and new orders all declined in 1954, continuing trends of other recent years. Dieselization of motive power continued, but at a sharply reduced rate. Some significance may be associated with the fact that 1954 was the first year on record, perhaps the first in railroad history, when not one new steam locomotive was reported installed.

In the first eleven months of 1954, 807 new locomotives were placed in service, including 792 diesels (1 008 units) and 15 gas turbine locomotives. The average of 73 new locomotives installed per month in 1954 compares with an average of 153 per month in 1953 and more than 200 per month in the three-year period 1950-1952 when dieselization programs were at their peak.

Table 13 shows the respective percentage of freight, passenger and yard services performed by the principal kinds of motive power in 1945 and in each year from 1949 to 1954. Whereas diesels performed less than 10 % of road services and only one-fourth of yard service in the last year of World War II, Diesel locomotives in 1954 accounted for 84 % of freight gross ton-miles, 86 % of passenger-train car-miles, and 89 % of locomotive-hours in yard switching service.

With electric locomotives maintaining about the same relative position in each year, steam power has shown a decline corresponding to the growth of diesel power. At the close of 1954 steam locomotives still accounted for about one-third of the locomotive ownership of Class I railroads, but relatively few engines of this type were actually in service and most « steam railroads » were using nothing but diesels. In fact, over 90 % of the freight gross ton-miles hauled by steam locomotives in the first ten months of 1954 was accounted for by only 15 railroads, and 60 % was made on just six railroads.

Dieselization of railroad motive power between 1945 and 1954 is graphically portrayed in Chart 9.

Progress in efficiency and economy.

The four tables next in series compare certain significant railroad performance averages for the first ten months of 1954 with annual averages for the calendar years 1945 to 1953.

One of the more significant performance averages is ton-miles (gross or net) per freight train-hour. That averages combines both load and speed factors. The unit output per hour of freight train oper-

TABLE 13. — **Locomotive utilization.**

Percentage of freight, passenger and yard services performed, by type of power.

Year	Steam locomotives	Diesel-electric	Electric and other
Freight service (gross ton-miles, cars and contents).			
1954 (10 months)	13.92 %	83.76 %	2.32 %
1953	23.42 %	74.64 %	1.94 %
1952	32.61 %	65.52 %	1.87 %
1951	45.51 %	52.65 %	1.84 %
1950	53.91 %	44.13 %	1.96 %
1949	63.05 %	34.89 %	2.06 %
1945	91.13 %	6.98 %	1.89 %
Passenger service (passenger-train car-miles).			
1954 (10 months)	8.03 %	85.75 %	6.22 %
1953	13.99 %	79.54 %	6.47 %
1952	21.83 %	71.53 %	6.64 %
1951	30.89 %	62.73 %	6.38 %
1950	36.31 %	57.30 %	6.39 %
1949	44.25 %	49.29 %	6.46 %
1945	84.45 %	9.59 %	5.96 %
Yard service (locomotive-hours).			
1954 (10 months)	9.64 %	89.48 %	0.88 %
1953	15.71 %	83.14 %	1.15 %
1952	22.01 %	76.72 %	1.27 %
1951	30.97 %	67.79 %	1.24 %
1950	38.20 %	60.45 %	1.35 %
1949	47.83 %	50.77 %	1.40 %
1945	73.11 %	25.55 %	1.34 %

ation is computed on two bases: (1) gross ton-miles of cars and contents per freight train-hour, and (2) net ton-miles (lading only) per freight train-hour. Both averages appear in Table 14.

Averages for the first ten months of 1954 indicate that new records for both factors will be set for the year. If that proves to be the case, it will mark the eighth consecutive year in which a new high performance record was established in that respect.

Chart 8 portrays the increase in net ton-miles per freight train-hour from 1945 to 1954.

Table 15 shows daily mileage averages for locomotives and freight cars for each

TABLE 14.

Ton-miles per freight train-hour 1945-1954

Year	Gross ton-miles	Net ton-miles
1954 (10 months)	53 844	23 869
1953	51 750	23 443
1952	49 113	22 565
1951	46 407	21 760
1950	44 352	20 343
1949	42 346	19 024
1948	39 903	18 778
1947	38 462	18 126
1946	37 057	17 173
1945	36 954	17 482

of the calendar years 1945 to 1953, and for the first ten months of 1954.

Active freight locomotives (serviceable excluding stored serviceable) in the 1954 period averaged 136.5 miles per day, 3.8 miles more than in 1953, the previous record year. Active passenger locomotives in the same period averaged 303.7 miles per day, surpassing the 1953 record performance by 15.8 miles. The progress achieved in these two averages in recent years is further indication of the importance of dieselization to the rail industry.

TABLE 15.

Daily mileage, locomotives and cars 1945-1954

Year	Active freight loco-motives	Active passenger loco-motives	Service-able freight cars
1954 (10 mos.)	136.5	303.7	43.5
1953	132.7	287.9	46.5
1952	126.8	266.1	46.2
1951	122.5	247.6	47.2
1950	119.3	237.2	46.5
1949	112.5	228.5	42.9
1948	116.8	220.9	47.2
1947	120.3	219.0	48.8
1946	115.9	221.8	45.2
1945	118.4	226.9	49.3

Serviceable freight cars (including serviceable surplus cars) averaged 43.5 miles per day in the first ten months of 1954, a decline of 3.0 miles under the 1953 average. The increase in idle serviceable cars during the period accounted for the decline in average utilization per serviceable car.

Train speeds (miles per hour between terminals) showed increases in both freight and passenger services during the first ten months of 1954. These averages appear in Table 16 for the calendar years 1945 to 1953 and for the first ten months of 1954.

Average freight train speed increased five-tenths of a mile over 1953, setting a new record of 18.7 miles per hour. Passenger train speed was four-tenths of a mile above the 1953 level, setting a record of 39.5 miles per hour.

TABLE 16.

Average train speed (mph) — 1945-1954

Year	Freight trains	Passenger trains
1954 (10 months)	18.7	39.5
1953	18.2	39.1
1952	17.6	38.3
1951	17.0	37.7
1950	16.8	37.4
1949	16.9	37.0
1948	16.2	36.7
1947	16.0	36.1
1946	16.0	35.5
1945	15.7	34.7

Table 17 shows average load per train and per car in both freight and passenger services. (See also Chart 10 covering freight data.) Figures for the calendar years 1945 to 1953 together with those for the first 10 months of 1954 are shown.

Each of these averages registered declines in the 1954 period, reflecting the depressed traffic volumes prevailing until the close of the year.

An outstanding safety record.

The overall safety performance of railroads in 1954 was again outstanding, and 1953 results were bettered in nearly every category.

The passenger safety record during the first ten months of 1954 was one of the best in history. During that period only four passengers lost their lives in train accidents (collisions, derailments, etc.), compared with 20 such fatalities in the corresponding period of 1953. There were 12 passenger fatalities in train-service acci-

TABLE 17. — **Average train and car loads — 1945-1954**

Year	Freight service		Passenger service	
	Net tons per train	Net tons per car	Passengers per train	Passengers per car
1954	1 288 (1)	31.4 (1)	93.2 (2)	17.5 (2)
1953	1 301	32.1	94.8	17.7
1952	1 296	32.5	98.4	18.1
1951	1 300	33.0	97.2	18.1
1950	1 224	31.7	88.5	17.0
1949	1 138	31.4	92.0	18.0
1948	1 176	32.9	100.8	19.4
1947	1 146	32.6	110.2	21.1
1946	1 086	31.3	143.7	24.7
1945	1 129	32.2	189.7	30.4

(1) Ten months.
(2) Nine months

dents in the first ten months of 1954 compared with 19 fatalities in the first ten months of 1953. Train-service accidents are usually the result of some form of carelessness on the part of passengers themselves, such as attempting to board or alight from moving trains. The fatality rate of 0.07 per hundred million passenger-miles for all passenger fatalities during the first ten months of 1954 ranks with the best such rates attained in prior years.

Employee fatalities during the first ten months of 1954 were lower by far than in any comparable period in the past. There were 171 employee fatalities for that period, compared with 252 for the same period of the preceding year. If this performance is maintained when reports are in for the balance of the year, not only will last year's all-time record of 0.11 fatalities per million man-hours be lowered, but for the first time in history the rate will fall below 0.10. Preliminary figures indicate a rate of 0.08 for the first ten months of the year. This is a real achievement when it is considered that the rate of 0.20 was broken for the first time in 1946, a scant 9 years ago.

Employee injuries in the first ten months of 1954 were also substantially below the corresponding period of 1953.

Highway grade crossing accidents trended downward in the first ten months of 1954 when there were 14.0 % fewer fatalities and 8.9 % fewer nonfatal injuries than in the same months of last year. This record is most gratifying in view of the steady increase in the number of motor vehicles on the highways.

How legislation affected the railroads.

Except for some remedial tax legislation, enactments of the second session of the 83rd Congress pertaining to transportation were limited principally to certain measures unfavorable to the railroads.

Ending long controversy with respect to one phase of the St. Lawrence Waterway, the President on May 13 signed into law S. 2150, providing for United States participation in the construction of navigation facilities in the International Rapids section of the St. Lawrence river. Since this act authorizes only part of the entire proposed project, there will undoubtedly be further issues raised with respect to the size of locks to be constructed by the

United States and as to improvements of connecting channels and harbors in the Great Lakes.

Over the objections of the railroads, Public Law 746 effectuated important changes in the railroad retirement and unemployment insurance systems which it is estimated will cost the carriers approximately $ 58 million annually. Also, the so-called « dual benefit bill » was enacted as Public Law 398, repealing Section 3 *b* (3) of the Railroad Retirement Act which had fixed maximum annuities payable for combined Social Security and railroad service performed prior to the effective date of the Railroad Retirement Act. Other bills proposing still greater additions to employee benefits under the railroad retirement and unemployment insurance systems failed to be reported out of committee and died with the adjournment of the 83rd Congress.

Tax measures enacted by the 83rd Congress affected the railroads in important respects. The comprehensive revisions contained in the Internal Revenue Code of 1954 included a number of relief measures which had long been sought by the railroads, with respect to such matters as depreciation, the pyramiding of lessor income taxes, elimination of the 2 % penalty for filing consolidated returns, and full recognition of the 85 % credit on intercorporate dividends in loss years. The Excise Tax Reduction Act of 1954 lowered the excise tax on transportation of persons from 15 to 10 % but afforded no relief at all from the 3 % tax on amounts paid for the transportation of property.

The Senate and House passed the so-called « government reparations » bill designed to establish the finality of contracts between the government and common carriers subject to the Interstate Commerce Act, but the President withheld his approval of this legislation, for reasons stated in a memorandum of disapproval dated September 2, 1954.

Various other transportation matters came before the second session of the 83rd Congress but were not acted upon, including the long-considered « time-lag » bill which the railroads had favored. Certain other bills which the railroads had opposed also failed of enactment such as the « operating rules » and « brake » bills, which would have extended the regulatory authority of the Interstate Commerce Commission with respect to these managerial responsibilities, and the « trip-lease » bill which would have deprived the Interstate Commerce Commission of necessary authority to regulate the duration and terms of truck leases. Congress also failed to act on bills to repeal Public Law 199 which limits the sizes and weights of parcel post and thus imposes some restraint upon government intrusion into the freight business in competition with private industry.

Judicial and administrative proceedings.

Only some of the outstanding developments in judicial and administrative proceedings affecting the railroads in 1954 can be noted in this brief survey.

Most important for their implications have been the « experiments » which the Post Office Department initiated in October 1953, and has since enlarged, for the movement of regular first-class mail by air carriers on a « space available » basis at special low rates. The railroads are opposing these ventures in the courts and before the Civil Aeronautics Board as unauthorized by law and because they are diverting to the domestic air carriers selected volumes of mail traffic while the railroads are obligated to continue to provide the department with what amounts to a stand-by type of mail service.

In the Seatrain Antitrust Case (*Seatrain Lines vs. Pennsylvania Railroad, et al*) Seatrain was permitted to file an amended complaint limited to subsidiary allegations under an order of the Third Circuit Court of Appeals dated September 30, 1953, which had sustained the district court's dismissal of Seatrain's principal

allegation to the effect that the railroads had unlawfully conspired to boycott Seatrain's services. While hearings were held June 21 on an amended complaint by Seatrain against six railroads, the district court has not yet ruled upon it.

In another antitrust proceeding, Riss & Co., an interstate motor carrier with principal offices in Kansas City, Mo., filed a complaint on September 22, 1954, in the U. S. District Court for the District of Columbia against 85 railroads, several railroad associations, and a public relations firm, charging that the defendants have injured the plaintiff by activities in violation of the antitrust laws. The complaint alleges that the plaintiff has sustained damages of $ 30 million, and seeks treble damages. In addition, the complaint seeks injunctive relief against the alleged activities of the defendants.

The general burden of the complaint is that the defendants have combined and conspired to oppose, harass, and impede the plaintiff's operations as an interstate motor carrier by the solicitation of state and local legislative, regulatory and administrative action unfavorable to Riss, have combined and conspired to abuse their right to intervene in proceedings before the Interstate Commerce Commission to prolong unduly proceedings involving Riss, and have combined and conspired to carry on a campaign of unfair competition against the plaintiff, through the dissemination of false propaganda about Riss.

On December 15, 1954, in answers filed to plaintiff's complaint, 23 western railroads asserted counterclaims for damage of $ 100 million, charging illegal and unauthorized operations by Riss in the hauling of explosives and other commodities between certain points in the West during the past 12 years. These railroads contend that they were deprived of revenue believed to exceed $ 100 million which would have accrued to them if Riss had not engaged in what they term illegal operations.

Reorganizations of two Class I railroads were completed in 1954 and bankruptcy proceedings were terminated for these carriers — the Wisconsin Central and the Long Island. Proceedings are continuing in other important reorganization cases, such as those involving the Missouri Pacific system and the Florida East Coast.

In Docket No. 31358, ICC Examiner Howard Hosmer recommended in a proposed report released December 8 that the commision enter a declaratory order finding that the daily freight car rental rates of $ 1.75 fixed in November 1949 and $ 2.00 established in May 1952 were reasonable when in effect, and that a reasonable rate for present use would be $ 2.10, in contrast with the daily rate of $ 2.40 which has been in effect since August 1, 1953. The examiner's report was filed after extensive hearings on a complaint instituted on September 21, 1953, by 19 of the major Class I railroads, resulting from a disagreement between those railroads and certain others concerning the reasonableness of per diem charges.

In a report dated July 30, 1954, the Interstate Commerce Commission made important rulings on the legal questions raised by the railroads' trailer-on-flat car service, frequently referred to as « piggyback ». Under Docket No. 31375, *Movement of Highway Trailers by Rail*, the commission gave consideration to twelve specific questions formulated by it as a result of the September 30, 1953, petition for declaratory order filed by the New York, New Haven & Hartford. Of primary importance was the question of whether trailer-on-flat car service constituted carriage by railroad, and therefore subject to Part I of the Interstate Commerce Act, or whether the operation was subject to Part II of the act, governing motor vehicle transport. The commission resolved this question in favor of the railroads, stating further that the railroads are authorized to perform trailer-on-flat-car service without motor carrier certificates.

Transportation studies and reports.

In 1954 President Eisenhower created two special committees to consider transportation matters.

Cabinet Committee on Transport Policy and Organization. Expressing concern that policies and programs of the government affecting the various forms of transportation should be « best designed » to help the transportation industry in its several branches to « maintain itself at maximum effectiveness », the President on July 12 established a Cabinet Committee on Transport Policy and Organization. The committee was directed to make a comprehensive up-to-date review of overall transportation policies and problems as an aid in assuring the « overall consistency » of government policies and programs concerning particular branches of the transportation industry.

Sinclair Weeks, secretary of commerce, was designated as chairman of the Cabinet Committee. The secretary of defense and the director of the Office of Defense Mobilization were designated to serve as members, with the secretary of the treasury, the postmaster general, the secretary of agriculture, and the director of the Bureau of the Budget participating on an *ad hoc* basis.

On September 2, 1954, the secretary of commerce announced the appointment of a Working Group for the Cabinet Committee under the direction of Arthur W. Page, of New York, who stated that while public hearings would not be held he would be happy to receive written statements from interested segments of the transportation industry. Accordingly, the railroad industry through the Association of American Railroads presented to the Working Group in September and October a series of statements, and a final summary, on subjects deemed appropriate.

It is understood that the Cabinet Committee had submitted its recommendations to the President, but at the year's end contents of the report had not been released.

Advisory Committee on a National Highway Program. On August 30 announcement was made from the White House of the appointment of General Lucius D. Clay as chairman of an Advisory Committee on a National Highway Program. On September 7 the following additional members of the committee were appointed : Stephen D. Bechtel, president, Bechtel Corporation; David Beck, president, International Brotherhood of Teamsters; S. Sloan Colt, president, Bankers Trust Company; and William A. Roberts, president, Allis Chalmers Manufacturing Company.

The Advisory Committee was appointed by the President to prepare « basic recommendations » for carrying out his concept of an improved national highway system as outlined by Vice-President Nixon in an address before the Governors Conference at Lake George, N. Y., on July 12. This address had suggested a need for increasing road construction expenditures by \$5 billion annually through the next ten years, over and above all current, normal expenditures. Such a \$50 billion program, the President advised, should be financed on the basis of « self-liquidation of each project », where possible.

In considering various approaches to these problems, the President's Advisory Committee was to work in co-operation with the Committee of the Governors Conference, headed by Governor Walter Kohler of Wisconsin, which had been appointed in July to formulate proposals in connection with the President's highway program. The President requested the Advisory Committee to submit its report and recommendations before January 5, 1955, when the next Congress was to convene.

At public hearings before the committee on October 7 and 8 more than a score of organizations responded to invitations to submit suggestions on the proposed highway program. At those hearings, the railroads emphasized as a fundamental principle of sound financing that « highways should be self supporting on the basis of

user charges, with equitable and adequate payments required from those who use the highways as freightways, including an allowance equivalent to ad valorem taxes. » Stressing the responsibility of the states for highway developments, the statement by the railroads concluded :

The best course is for the states to take more vigorous action to improve their systems of highway user charges, requiring adequate weight-distance taxes on heavy commercial trucks, both domestic and out-of-state, and to take effective measures to protect highway facilities against abuse and destruction by heavy freight vehicles. The states should not be relieved of this necessity by undue federal grants-in-aid.

The competitive situation in 1954.

Competitive conditions in transportation, particularly those attributable to public policies, continued in 1954 to work strongly against the railroads. Indications are that the railroad share of total inter-city traffic again declined in 1954, prolonging the downward trend which has been in evidence since World War II.

The influence of the government on transportation extends over a broad range of policies and actions in the fields of regulation, promotion, use and taxation. In each of those areas existing policies and practices are contributing to erosion of railroad traffic, rate structures and earnings. Whereas the railroads are privately owned, self-supporting and tax-paying businesses subject to rigid regulation of their own operation, their principal competition is from means of transportation which are regulated only to a limited extent or not at all, and are heavily subsidized through the provision of basic facilities at public expense without the requirement of adequate user charges from those who are advantaged.

The railroads also have been affected adversely by actions of the government as a user of transportation service. Beginning in the latter part of 1953 and continuing throughout 1954., the Post Office diverted from the railroads to domestic scheduled air lines on a « space available » basis increasing volumes of first-class mail in programs described as « experimental ». The diversion of regular mail from the railroads to trucks, on a contract basis, was further extended in 1954. The Department of Defense continued to make extensive use of irregular and contract operators by air for the movements of military personnel.

In the tax field, the discriminatory wartime excises on transportation of persons and freight by for-hire carriers remain in effect, penalizing such carriers in their competition with private means of transportation. In these various ways the government is imposing serious handicaps upon common carrier transportation by railroad.

It may be hoped that the comprehensive review of transportation policies by the President's Cabinet Committee will focus attention upon these unbalanced conditions of competition in transportation and that its recommendations will lead to needed corrective actions. There are indications of growing awareness that remedies are required. The present chairman of the Interstate Commerce Commission in an address on November 18, noting that there has been a complete change in the transportation industry within the past 30 years, said :

But in the face of this change in transportation — from a monopoly to a competitive system — I find that regulation has not changed. Today regulation is practically the same as it was 30 years ago. But I say to you, regulation must change. The old rules are as much out of date as the horse and buggy.

In the same vein the undersecretary of commerce for transportation, Robert B. Murray, Jr., recently stated :

Some of our federal transportation policies — particularly as they affect the railroads — stem basically from the transportation station as it existed many years ago. They stem from that period when the railroads had virtually a

monopoly position. We find regulatory and promotional policies designed to foster and protect some of the other media in the transportation fraternity. We even find regulation intended to protect the railroads from themselves.

In the meantime, of course, some of the other forms of transportation have become potent factors in their own right. They have brought highly competitive conditions into the transportation industry. However, the railroads, still operating under earlier regulatory concepts, are not always in a position to enter fully into this competitive race.

An appraisal of the outlook for 1955.

The year 1954 drew to a close with indications that the upturn in business activity which got under way in the fourth quarter may continue into the first half of 1955 and perhaps beyond. There are increasing manifestations that strong growth factors may be expected to bring continuing gains to the nation's economy for years to come, although the rate of such growth seems likely to be moderate and will, as in past periods, be subject to interruptions from time to time.

A notable feature of present expectations of moderately higher business levels in 1955 over 1954 is the uniformity with which improvements are anticipated for various key segments of the economy, such as steel output, construction activity, coal production, and the manufacture of automobiles. In such important segments of the economy, and with little or no expression of contrary views on the pessimistic side, it has been estimated that gains may range from 5 to 10 per cent over 1954. *No upset is presently in sight for any major line of activity.* With prospects of continuing large governmental outlays for defense and other purpose, it would appear at this time to be a conservative estimate that total industrial output in 1955 may be about 5 per cent greater than in the year just past, but still slightly under the high level attained in 1953.

While it may reasonably be expected that railroad traffic would respond to such higher levels of general economic activity, in other important respects the outlook for the railroads is still somewhat clouded. It has been noted that rail traffic and earnings in 1954 fell off much more sharply from 1953 than did the economy and output as a whole. This is partly attributable to severe declines in industries which furnish large volumes of traffic to the railroads, such as coal and steel and its products and components. Their continuing revival to higher levels would doubtless contribute to increased rail tonnages.

But the railroads continue to operate under serious handicaps in their efforts to compete with favored and protected means of transportation. With respect to these adverse conditions no sudden reversal is in sight. Prospects for improved earnings of the railroads also depend upon the outcome of proposals for further wage increases and other employee benefits which previously have so fully absorbed rising gross revenues and the results of increasing efficiency of operations.

Expenditures of the railroads for capital improvements in 1954 fell to approximately $810 million, or about 35 per cent below the preceding year. Such capital expenditures are a continuing necessity if a strong and improving railroad system is to be maintained for the nation's commerce and defense. Since the railroads must rely chiefly upon internal sources of funds with which to finance such improvements, higher levels of traffic and earnings are needed to attain these desirable results, to the benefit of the shipping and traveling public and the national security.

[**625** .144 .4 (42) & **625** .172 (42)]

Weedkilling train and portable equipment.

Converted locomotive tenders and spraying apparatus used in the Western Region.

(*The Railway Gazette*, December 24, 1954.)

An article by a correspondent in our December 10 issue discussed the problem of keeping down weeds and grass on railway premises, and mention was made of chemical sprays applied by various types of spraying machinery including, on British Railways, trains specially equipped. We are indebted to Mr. M. G. R. Smith, Civil Engineer, British Railways, Western Region, for the following details of the special spraying train and equipment used in that Region.

The usual formation of the weedkilling train used is : engine; three converted tenders; tank wagons of weedkiller (usually not more than three); operators' living van; and brake-van. The maximum weight of the train loaded is about 200 tons excluding the engine.

The three converted locomotive tenders, in one of which is fitted a steam pump, are fitted with a steam pipe, an overhead delivery pipe from the pump to each tank, and a gravity feed pipe which leads to a sump under the tender containing the pump.

There is also a suction point on the pump for a flexible pipe to the rail tanks of weedkiller. A by-pass on the pump delivery pipe operates if the pressure exceeds 60 lb. p.s.i. and returns the excess mixture to the tanks.

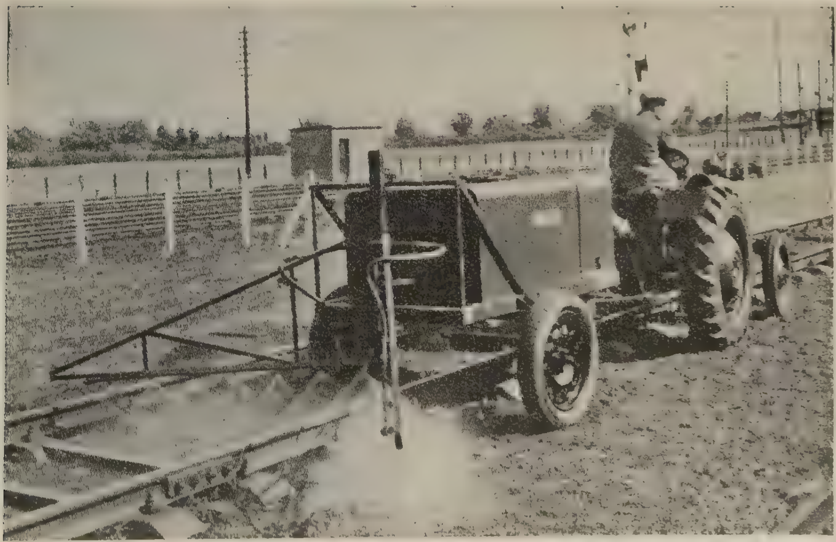
Train marshalled in usual order : three tenders equipped for spraying; tank wagon of weedkiller; operators' living van; and brakevan.

The total capacity is 9 500 gal.; jets from the steam pipes in each tank are used to stir the mixture during running.

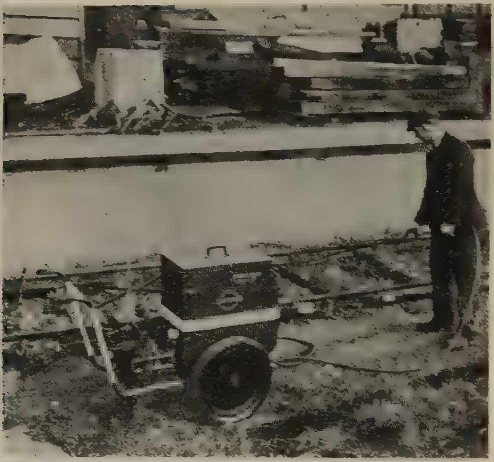
There are nine spraying nozzles, the outer two on each side being fixed to retractable arms. Guards are fitted under the spraying boom so that the weedkiller is not sprayed on to the head of the rail where it might cause rail slip.

Spraying equipment on tender, showing overhead delivery and feed pipes and spraying nozzles.

Spray in action.



Weedkilling demonstration at Lacock Halt sidings, using Bristol Ferguson tractor and Bristol power sprayers.



Aerostyle weedsprayer, showing four-stroke petrol engine and pump

Weedkiller mixture.

The mixture normally used is five parts of water to one part of weedkiller; but this may be varied slightly to suit local conditions.

With a steam pressure of 60 lb. p.s.i. and train proceeding at 20 m.p.h. the train sprays 400 gal. of mixture per mile of track. The total width of spray is 17 ft.

Weedkilling is also carried out by equipment coming under the heading of portable plant, as specified below.

Aerostyle weedsprayer.

The Aerostyle weedsprayer comprises a steel chassis plate mounted on pneumatic tyres at the rear and ball bearing swivel castor at the front. A 20-gal. capacity tank is bolted to one end of the chassis plate and fluid emission is controlled by means of a stop valve at the pump to which a 30-ft. length of special solvent-resisting hose is attached for connection to the spray lance.

The power unit comprises a 1-H.P. four-stroke petrol engine driving the Aerostyle pump through a flexible coupling.

Allen motor scythe

The Allen motor scythe has been adapted to operate a pump for spraying weedkiller. The pump will maintain a pressure of 200 lb. p.s.i. with an output of two gal. per min. The basic set of equipment consists of a 4-ft. lance complete with adjustable vortex and three jet discs with a quick operating tap; 30 ft. of high pressure hose; and 15 ft. of suction hose with strainer.

This equipment can also be provided with a carrier attachment for conveying the tank of liquid weedkiller.

There is also the equipment comprising a tank of 120-gal. capacity mounted on two pneumatic-type wheels, with an internal agitator which, with the pump, is driven from the power take-off on a Ferguson tractor.

The weight of the spraying machine is 14 cwt. and the liquid is sprayed at a pressure from 75-100 lb. p.s.i. through two booms 5 ft. long, each extending from the rear and at right angles to the machine; there are seven nozzles to each boom.

Allen spraying pump.

[**621** .138 .5 (73) & **621** .431 .72 (73)]

For large Diesel facility... New concept in shop ventilation.

(*Railway Track and Structures*, December, 1954.)

Santa Fe's new diesel shop at Kansas City is equipped with system incorporating fresh-air ducts with outlets at top-of-locomotive level along sidewalls. Exhaust fans in roof bring fresh air in under rising diesel exhaust fumes and pull fumes out through roof, preventing them from penetrating to working level below. Radiant heating system in the concrete floor heats the working area.

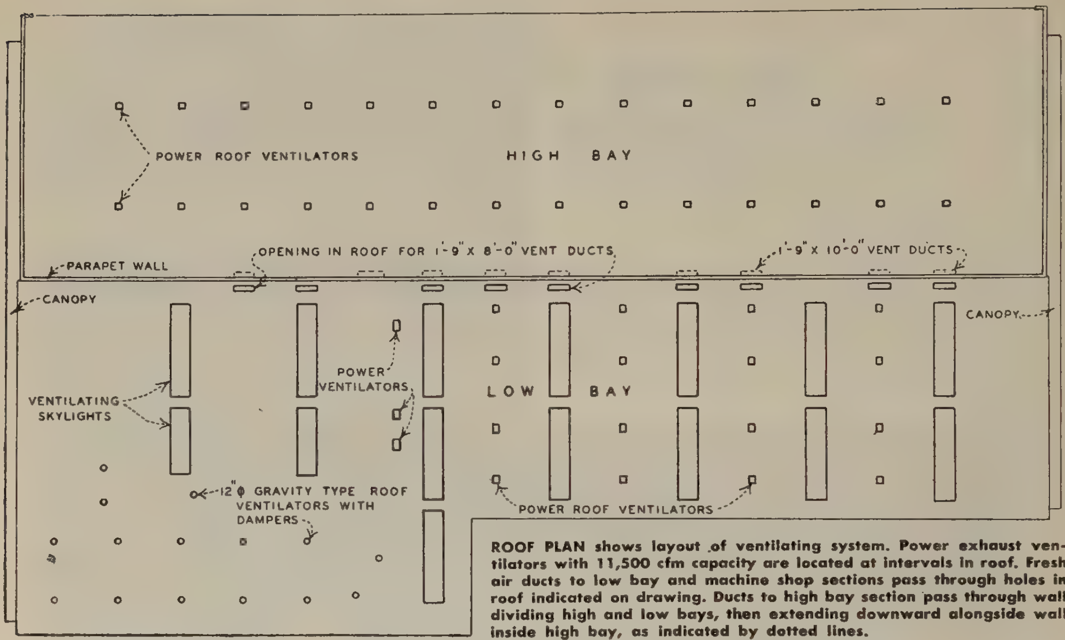
Shop building is one of largest and best equipped of its type yet built. At right is heavy repair section with running repair portion located at left.

The thorny problem of heating vs. ventilating in diesel shops - how to combine and balance the two during cold weather so that employees in the shop area can work in reasonable comfort - has been tackled in an unusual way in a new shop the Santa Fe has built at Argentine (Kansas City), Kan.

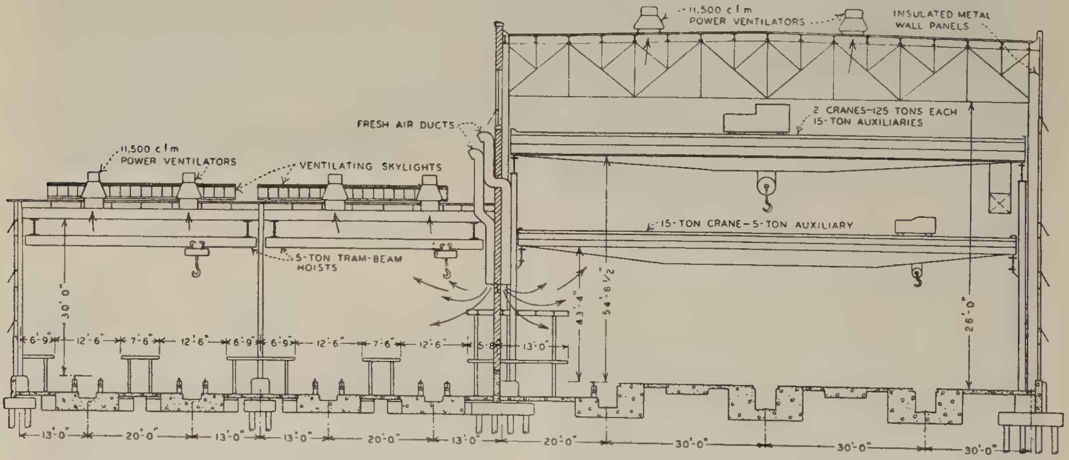
The new shop building, reportedly one of the largest and best equipped diesel facilities yet to be built, handles maintenance, form inspection, servicing and some heavy repair work on 383 diesel locomotive units. The building proper is 260-ft by 400-ft in plan and consists of three principal sections : A high bay extending the full length of the north side of the structure; a low bay situated along-side the high bay and extending about half the length of the building; and a 2-story portion comprising offices, storerooms, a machine shop, a parts cleaning room and wash and locker rooms.

The ventilating theory.

A ventilating system has been installed in both the high and low-bay sections, which involves a comparatively new concept



ROOF PLAN shows layout of ventilating system. Power exhaust ventilators with 11,500 cfm capacity are located at intervals in roof. Fresh air ducts to low bay and machine shop sections pass through holes in roof indicated on drawing. Ducts to high bay section pass through wall dividing high and low bays, then extending downward alongside wall inside high bay, as indicated by dotted lines.

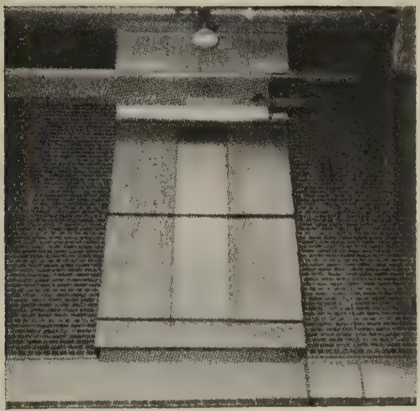


Ventilating system in shop sections employs fresh air outlets along sidewall at about top-of-locomotive level. Fresh air is drawn in under rising diesel exhausts and the fumes sucked out through roof by power ventilators.

centered around the establishment of a restricted « zone » of air circulation. Basis of this concept is the fact that diesel fumes rise while warm, but on cooling have a tendency to settle. In designing the Argentine shop, a means was sought whereby diesel fumes could be carried out of the shop area before becoming sufficiently

cool to settle into the working level. Overhead crane installations in both the low and high bays precluded the use of hoods over the tracks.

A system employing exhaust fans in the roof drawing fresh air from the floor level up was not considered desirable for winter operation since satisfactory heating of the working level with such an arrangement would be difficult, if not impossible. It was felt though, that if the air circulation could be restricted to a zone above the working level, the heating of the lower portion could be accomplished more easily.



Fresh air ducts have dampers at outlets controlled by chain mechanisms.

Accordingly, a system was developed which brings in fresh air along the side walls of the shop area at about the level of the top of a locomotive unit. Exhaust fans in the roof draw this fresh air in under the diesel exhausts. The fresh air is then pulled upwards through the roof, carrying the diesel fumes with it. Air circulation theoretically does not penetrate to any great extent below the top-of-locomotive level, and the incoming supply of fresh air forms, in effect, a protective layer between the diesel fumes and the working level.

The fresh-air ducts are of metal and are 1 ft. 9 in. by 8 ft. in cross section. They are installed with outlets at intervals along both sides of the wall dividing the high and low bays. Nine ducts serve the high bay, and seven the low bay. There are also two ducts feeding into the parts cleaning and machine shop areas.

In the roof of the high bay there are 28 Ilg power exhaust ventilators, with a capacity of 11 500 cfm each. The roof of the low bay has 16 units of the same type. In addition there are three fans which exhaust air from the parts cleaning and machine-shop sections.

Radiant heating in shop area.

Heating in the shop sections is provided by a radiant system consisting of Byers wrought iron pipe, embedded in the concrete floors. Warm water circulated through the tubing is maintained at a constant temperature, usually around body temperature. The rate of circulation is varied by thermostatic control, increasing or decreasing as the outside temperature goes down or up. The radiant system causes a continuous supply of warm air to rise from the concrete floors, thereby maintaining the entire working area at a comfortable temperature. Water for the system is heated by steam which, along with other steam requirements in the shop, is supplied from a central power plant serving all of the Argentine facilities.

NEW BOOKS AND PUBLICATIONS.

[**385**.(08 (460)]

RED NACIONAL DE LOS FERROCARRILES ESPANOLES. — Memoria del Consejo de Administración. Ejercicio 1953. *(Spanish National Railways. Report of the Management for the year 1953.)* — One volume (8 1/4 × 12 in.) of 132 pages, illustrated. — 1954, Artes Graficas y Edicione S.A., Rodriguez San Pedro, 32, Madrid.

The year 1953 closed with very little change in the traffic : a slight increase in the passenger traffic units and a small reduction in the freight tons-kilometres. The improvement in the case of passenger traffic is attributable in particular to the new facilities offered to the public. The volume of freight traffic was affected by economic circumstances.

The operating coefficient was slightly higher than that for the previous year : 107.89 % compared with 107.27 %. Although the receipts did not greatly increase, the costs had to meet the greater train mileage and differences in price of various materials, amongst other things coal.

Although still in the middle of the period of restoration and modernisation of the fixed equipment and traction and rolling stock, this railway which extends to 13 067 km (8 118 miles) gives us much to think about from various points of view.

Chapter I of the report analyses the working of the railway.

Chapter II comments on the economic and financial results.

Chapters III and IV contain many details about the permanent way works, fixed installations and rolling stock.

Chapter V deals with the part played by the railway in forestry undertakings.

Chapter VI deals with the position as regards road transport and the policy followed by the RENFE in this respect.

The last chapter gives a table showing the various charges falling on the railway, which taken as a whole form an impressive total.

The 32 tables included in the appendices give detailed statistics which could not be included in the body of the report.

E. M.

[**385** (08 (59)]

HARRISON (C.G.), A.M.I. Mech. E., M.I. Loco. E., M.I.I.A., General Manager Malayan Railways. — **Federation of Malaya. Malayan Railway Administration Report for the year 1953.** — 1954, Kuala Lumpur, Charles Grenier & Son, Ltd. — A brochure (8 1/4 × 12 in.) of 81 pages, with map.

The year 1953 was characterised by improved operating results. The receipts increased and costs were reduced.

The attacks of terrorists were much fewer, so that the resulting costs were also reduced. In addition, the train services were much closer to normal, with improved timetables, higher passenger traffic receipts and lower operating costs.

The freight traffic also increased, but the receipts did not increase to the same extent in spite of increased rates for the lower tariff classes, special tariffs having been introduced to meet road competition.

As a result of the completing of the important bridge at Bertam, the line running northwards to the Siam frontier could be reopened to traffic. The length of line

operated has increased by some 72 miles and this has also made it possible to reorganise the train services.

The 16 chapters composing the present report in addition to giving general details about the position of the railway, include a description of the fixed installations and rolling stock with brief details about the activities of the various departments.

Detailed statistics given in the appendices make it possible to appreciate the activity and efficiency of the transport services both from the technical and financial points of view.

E. M.

[385 (08 (593)]

State Railway of Thailand. Annual Report for the Year Buddhist Era 2495. — A booklet (8.3 × 13 inches) of 86 pages, illustrated. — Bangkok, The State Railways of Thailand Printing Office.

As from the year 2494, the operation of the State Railways of Thailand was given to an autonomous Authority. This report therefore relates to the second year of the new regime.

During the previous year, the chief activity was the reconstructional and restoration work necessitated by damage which occurred during the South-East Asiatic War. The year 2495 saw the continuation and the completion of the greater part of the work put in hand.

Apart from the tracks and fixed installations that had to be restored, there was a considerable amount of rolling stock to be replaced or repaired. The report gives many exact details about all these various points. The information is also summed up in Part I : General Report.

The other parts, 15 in all, paint the situation on all sectors of the railway.

In the second part, which deals with the capital and financial results, it will be seen that the receipts have increased as compared with the previous year, owing on the one hand to an increase in the rates and on the other to an increase in the traffic. In spite of the fact that costs also rose, there was a net profit making the average operating coefficient for the year 81.50 %.

In spite of these encouraging results, the report has to admit that the railway is not yet in a position to meet all the requirements of the public. The lack of rolling stock is the chief cause of this. The last chapter lists the measures taken to obtain locomotives and rolling stock to improve the train services, as well as to meet all the reconstructional work still to be carried out.

E. M.

[385 (08 (946)]

Tasmania. Report of the Transport Commission on the operations, business, and affairs of the Transport Department during the year ended 30th June 1953. — A booklet (8 × 13 inches) of 64 pages. — 1954, L.G. Shea, Government Printer, Tasmania.

This report consists of two parts : a general report of the situation and activities of the undertaking and a great many appendices giving very detailed statistics.

The general report deals in the first instance with the financial situation. In spite of an increase in the receipts, the deficit increased chiefly on account of the staff costs and to a lesser extent on account of the rise in the cost of materials.

There was also an increase in the financial charges due to increases in the capital invested. This is due to the carrying out of a restoration and modernisation

programme the effects of which will be to eliminate much costly maintenance of worn stock, increase the train loads, and speed up the turn round of the stock.

This first part of the report also contains an analysis of the operating and traffic, as well as data on the activities of the various departments, who share the responsibility for the running of the railway.

The information given in the appendices are first of all of a financial and accountancy nature. They also cover the mileage of the stock, both traction and rolling stock, and the chief traffic components. As a whole they give a complete and faithful picture of the activities of the railway.

E. M.

[**385** (05)]

Jahrbuch des Eisenbahnwesens 1954. *(Railway Annual 1954.)* — Published by Berthold STUMPF, Frankfurt (Main). — A volume (8 1/4 × 11 3/4 inches) of 208 pages, with numerous drawings, diagrams, figures and tables. — 1954, Darmstadt, Carl Röhrig-Verlag oHG, Stephanstrasse, 8. (Price : DM. 7.20.)

This is the fifth issue of this annual which made its first appearance in 1950. It has now taken on the definite form of a collection of a series of articles by well known authors.

The articles included in this issue deal above all with technical questions as well as the operating properly speaking.

To sum up there is a study on transport in the European community of coal and steel, another on the development of signalling and communication installations, another on innovations in the field of electric traction. The motor services of the D.B. are dealt with in two articles one covering the road services in general, and the other the transport of very heavy loads. This group also includes the question of special wagons belonging to the D.B., and an historical and technical report on navigation on the Lake of Constance.

Amongst subjects rarely dealt with in railway literature, mention must be made of that which its author calls : Beauty and Fashion in the construction of steam locomotives. Without mentioning every article, we must draw attention to a systematic report of the historical development of steel bridges in Germany.

Special mention must also be made of an article called « Shadows of the Past, Illusions of the Present. » a dissertation on the evolution of costs and receipts on the D.B. and an analysis of the causes of this situation.

This article should be read in conjunction with the editorial note which gives a picture of the working of the Deutsche Bundesbahn during the year 1953.

E. M.

[**385** (09. 3 (494)]

MATHYS (E.), former Librarian of the Swiss Federal Railways. — **Beiträge zur Schweizerischen Eisenbahngeschichte** *(Contributions to the History of the Swiss Railways).* — One volume (5 1/2 × 8 1/4 inches) of 172 pages, with map and 88 illustrations. — 1954, Bern, Kümmerly & Frey A.G., Geographischer Verlag, Hallerstrasse 6/8. (Price : 9.50 Swiss fr.)

The author, who was for a long time the librarian of the Swiss Federal Railways, has not only devoted himself to collecting an invaluable library, but also knows inside and out all the works dealing with the railway field therein. His previous experience as an official in the operating and administrative departments of the Swiss Federal

Railways has enabled him to draw the essential facts from this documentation.

Many questions are dealt with and presented in the most interesting possible fashion in this very condensed volume.

Naturally the history of the birth of the three Alpine lines, the St. Gothard, Simplon and Lotschberg takes pride of place to start with. A very exciting history, with many dramatic moments, during which innumerable difficulties of all kinds had to be surmounted. Well deserved homage is paid to the great men whose names will ever be associated with this gigantic work.

In a previous chapter « Known and unknown facts about the St. Gothard line » the author recalls the interminable discussions which took place about the projected proposals and the many administrative and financial crises which occurred while it was being carried out.

In passing, he pays particular attention to the nationalisation and electrification of the railways.

Amongst other subjects dealt with, mention must be made of telecommunications, the choice of the gauge, the direction of running of the trains, the train numbering, the denomination of the locomotives, the campaign for night trains.

With its copious and well varied illustrations, this work gives a masterly picture of one particular aspect of the history of Switzerland. It is a tribute to several generations of great men who devoted themselves to the creation and perfecting of an incomparable instrument of civilisation.

E. M.

[**656** .28 (42)]

Lt.-Col. G.R.S. WILSON, C.B.E., Chief Inspecting Officer of Railways, Ministry of Transport and Civil Aviation. — **Report to the Minister of Transport and Civil Aviation upon the Accidents which occurred on the Railways of Great Britain during the year 1953.** — A booklet (5.9 × 9.6 inches) of 70 pages. — 1954, Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2 and 432, Oxford Street, London, W.1. (Price : 2 s. 3d. net.)

This report follows the usual lines. Detailed statistics are given in the appendices. Others in a more condensed form are included in the body of the work where they are accompanied by suitable commentaries.

The accidents are grouped into three classes : accidents to trains, accidents in connection with the services and other accidents. In each of these three classes, we are given the number of accidents in which passengers, railway employees and other persons were involved.

The report makes a comparison between the number of train accidents in 1953 and divides these up according to the cause thereof.

In the case of the 16 accidents, which were the subject of an official enquiry, the author analyses briefly the circumstances, the chief cause or causes, and gives the measures which could be taken or are under consideration to prevent a recurrence.

An important passage is devoted to accidents at level crossings.

A thorough study is also made of the causes of accidents under headings II and III : accidents caused by the train services, and other accidents.

Under the heading « Review of the Year », the author sums up the various classes of accidents, with comparative figures for previous years, the circumstances and any lesson that could be learnt from them.

In his conclusion, he sums up his impressions regarding the degree of safety offered by railway transport, the happy effects of the excellent condition of the track, the rolling stock and all the equipment, and the

quality of the staff. Present circumstances are such that the favourable situation can be maintained and even improved still further, and safety will also profit by the modernisation programme to which the British Transport Commission is now devoting its whole attention.

E. M.

[**624** .9 & **721**]

Dr.-Eng. Hermann MAIER-LEIBNITZ, Professor at the Stuttgart Upper Technical School. — **Vorlesungen über Statik der Baukonstruktionen.** Tome III. *(Statics of Building Construction bourse. Volume III)*. — A volume (8 1/4 × 11 3/4 inches) of 292 pages, with numerous figures. Editor : Franckh'sche Verlagshandlung W. Keller & Co., 5-7, Pfizerstrasse, Stuttgart. (Price : DM. 29.50.)

The firm Franckh'sche Verlagshandlung of Stuttgart has just published to the same high standard, which may even be said to be perfection, Volume III of the *Statics of Building Construction Course* by Professor Dr. Eng. E. h. Maier-Leibnitz.

I reviewed Volumes I and II in the *Bullletin* for January 1953 and stressed the originality of the methods of exposition, which were always accompanied with many practical examples, gone into methodically, progressing from the simple to the complex.

These invaluable characteristics are to be found again in Volume III, which though linked up in certain points with Volumes I and II, is a complete work in itself, and is divided into three parts.

The first part deals with the calculation of isostatic trellis frameworks in plan and in space.

The second part is a thorough study of deformations based on the ideas put forward by Otto Mohr in his work : « Abhandlungen aus dem Gebiet der Technischen Mechanik », Berlin 1914.

It is well known that the principle of virtual displacements and their consequences are often used in Germany.

In brief $\Sigma Q\delta = \Sigma s.\ \Delta s$ equality between two products : forces x displacements according to the forces.

First group : exterior forces Q in equilibrium with the exterior reactions they provoke.

Second group: covering the internal stresses in the bars of the trellis.

The same relation exists in the case of structures with plain webs.

Theoretical reports are followed by numerous numerical applications of great didactic value.

The third and last part of Volume III is devoted to a study of both isostatic and hyperstatic systems, including the lines and coefficients of influence.

In conclusion, we can very well understand the well deserved praise that the technical press both in Germany and abroad has showered upon Professor MAIER-LEIBNITZ for this three volume course on the statics of construction, which can be well summed up in the words of *Wasser und Boden* of Hamburg : « Das Buch kann als Standardwerk fûr die Ausbildung des studierenden und fûr die Praxis der Bauingenieure und Architekten angesehen werden. »

It is therefore a standard course both for the training of students and the practical use of contructional engineers and architects.

Pierre DUBUS,
Civil Engineer A. I. Br.

[624]

Brückenbau und Ingenieurhochbauten *(The construction of bridges and other above ground structures).* — *E.T.R. Eisenbahntechnische Rundschau.* Sonderausgabe 4. *(Technical Railway Review. Special issue No. 4, July 1954.)* — One brochure (8 1/4 × 11 inches) of 144 pages, illustrated with numerous figures and plates. — 1954, Darmstadt, Carl Röhrig-Verlag oHG, Stephanstrasse, 8. (Price : DM. 18.—; membership E.T.R. : DM. 14.—.)

The Monthly Review E.T.R. announced in its first issue that from time to time special issues would be published devoted to some single subject of particular importance. This one deals with the construction of bridges and other large structures of engineering art.

The great number of bridges on the German railway system, the capital they represent and the maintenance costs to which they give rise are sufficient to justify the interest which the publishers of this review attach to this question.

The rise in costs and reasons of a financial nature have inspired the research into economic ways of maintaining old bridges in service. In the case of new constructions recent discoveries in connection with materials, calculations and general arrangement as well as protection against destructive forces, have been made full use of. In this field, the various contributors to this issue have described some remarkable work and reported on new theories and recent processes.

This issue consists of ten notes, the first of which gives a picture of the evolution of the technique of building railway bridges on the Deutsche Bundesbahn.

The second deals with the essential materials, concrete and steel, used in the construction of railway bridges.

The third deals with typical loads, and reports a method of calculation to determine the admissible loads on existing bridges.

The author of the fourth note describes certain metal bridges made of welded trellis rivetted together and reports on the advantages of trellis construction.

The fifth deals with the reinforcement of road bridges and railway bridges by means of a concrete decking, if necessary prestressed.

The sixth describes the most recent railway bridges built of prestressed concrete and studies the advantages of this method as well as the quality of the materials used.

The seventh deals with the problems arising in connection with the use of prestressed concrete for building. This study is based on trials carried out by the Deutsche Bundesbahn.

The halls of large stations and covered in platforms are the subject of the eighth note which discusses the two solutions now used.

The ninth note deals with the possibility of internal corrosion in the case of hollow sections and gives the methods of preventing this.

The author of the tenth note describes the organisation of the maintenance of bridges on the German railways.

E. M.

[385 09 .3 (436)]

Hundert Jahre Semmeringbahn. — Festschrift der Österreichischen Bundesbahnen zum Gedenken an eine bahnbrechende Leistung heimischer Technik. (*The Centenary of the Semmering Railway.* Report issued by the Austrian Railways in memory of a creative work of the national technique). — A booklet (8 1/4 × 11 3/4 inches) of 32 pages, with numerous photographs. — 1954, Editor : Gof-Verlag Gustav O. Friedl, Passauerplatz, Vienna I.

One hundred years ago the Semmering Railway penetrated the range of the Austrian Alps, which separates the Danube from the Adriatic.

This achievement, remarkable on account of the size of the programme carried out, was an important stage in the development of transport : it put the capital of Austria

in direct communication with the town of Trieste. Up till then passengers and freight had to cross the moutains on horse-drawn vehicles. The value of a direct connection with the great port on the Adriatic will be readily appreciated.

Extraordinary difficulties had to be surmounted by the audacious promoters of this undertaking. Compared with present day technical resources, they only had very primitive equipment to surmount these.

Another fundamental question arose. At that time the steam locomotive had already demonstrated its ability on lines in the plains, but in this case the line would have very steep gradients and it was not certain that steam was equal to the job.

This doubt was removed by the organisation of a competition recalling that of Rainhill in which four locomotives took part, the winner being the « Bavaria » of J. Maffei at Munich.

The first article gives the history of the origins of the Semmering line. It describes the economic circumstances which gave rise to the numerous studies and proposals from amongst which Dr. Karl Ritter von Ghega's project finally emerged. He was in reality the creator of this line. The reader will find the narration of the numerous incidents which marked the creation and putting into service of this celebrate railway extremely interesting.

A second article gives technical data on the constructional work and many bridges needed to scale the Semmering range.

In a third note, the author deals with the evolution of the locomotives from the beginning to the present time. Recently, the use of Diesel traction has made it possible to shorten the train times between Vienna and the various capital cities oı the South.

The operating point of view is gone into in the final note. This shows how the organisation of the train services was progressively improved, as well as the rolling stock, and how the traffic continually improved.

The Minister of Transport and the General Manager of the Federal Railways, each in a preface, have paid tribute to the greatness of a work which marks an epoch in railway history, and to all those who contributed to its realisation.

E. M.

MONTHLY BIBLIOGRAPHY OF RAILWAYS (1)

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(JULY 1955)

[**016.** 385 (02]

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1955 — **621** .31

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Paris, Dunod, éditeur, 92, rue Bonaparte. Un fascicule (24 × 31 cm) de 60 pages, contenant 3 études, avec illustrations. (Prix de cette livraison spéciale : 430 fr.fr.)

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Rapports à l'Assemblée générale ordinaire du 9 mars 1955. *Exercice* 1954, 74e exercice social.

Bruxelles, édité par la Compagnie ci-dessus, 33, rue de l'Industrie. Une brochure (22.5 × 29.5 cm) de 22 pages.

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Paris, Editions Dunod, 92, rue Bonaparte. Un volume (10 × 15 cm) de 178 pages, avec 247 figures. (Prix : relié, 480 fr.fr.)

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Crémonas et barèmes pour le calcul des charpentes métalliques. (3e édition.)

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b) **Iron and steel structures;**

c) **Wood bridges and trestles;**

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[016. 385 (05]

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PAHIN (J.-A.). — Nouvelle application des **liaisons radiotéléphoniques dans le triage de Miramas.** (1 000 mots & fig.)

1955 **621** 431 .72 (65)
La Vie du Rail, 20 février, p. 8.
Les **nouvelles C.C. Diesel-électriques** des Chemins de fer Algériens. (1 000 mots & fig.)

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1955 **656** (43)
Die Bundesbahn, Nr. 2, Januar, S. 104.
KNEBEL (H.). — Das **Flugzeug als Beförderungsmittel des innerdeutschen Personenverkehrs.** (3 000 Wörter & Tafeln.)

1955 **385** .572 (43)
Die Bundesbahn, Nr. 2, Januar, S. 112.
FINGER (H.-J.). — Der **Beamte auf Probe.** (4 000 Wörter.)

1955 **656** .212 .6 (43)
Die Bundesbahn, Nr. 2, Januar, S. 118.
PEISKER (K.). — **Mechanisierung der Zuckerrübenumladung auf Güterwagen.** (6 000 Wörter & Abb.)

1955 **656** .1
Die Bundesbahn, Nr. 3, Februar, S. 152.
WERSCHE (D.). — **Regelung des Güterkraftverkehrs** in der Bundesrepublik, den westeuropäischen Ländern und der U.S.A. Verkehrspolitische Auswirkungen. (4 000 Wörter & Tabellen.)

1955 **656** .257 (43)
Die Bundesbahn, Nr. 3, Februar, S. 169.
GEIB (E.). — **Beibehaltung ferngestellter Weichen auf Strecken mit vereinfachtem Nebenbahndienst.** (2 000 Wörter & Tabellen.)

1955 **656** .1 & **656** .2
Die Bundesbahn, Nr. 3, Februar, S. 174.
ENGLBERGER (F.). — Der **kombinierte Schienen-Strassen-Schwerlasttransport.** (2 000 Wörter & Abb.)

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1955 **625** .234 (43)
Deutsche Eisenbahntechnik, Januar, S. 38; Februar, S. 84.
HÖER (W.). — Die Entwicklung der **Reizezugwagenbeleuchtung** bei der Deutschen Reichsbahn unter besonderer Berücksichtigung der neuzeitlichen Beleuchtung mit Leuchtstoffröhren. (7 000 Wörter & Abb.)

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1955 **625** .143 .4
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RUBIN (H.). — Betrachtungen über die **Stosslücken im Gleis.** (3 000 Wörter & Abb.)

1955 **624** (43)
Der Eisenbahningenieur, Februar, S. 37.
FREY (H.). — Ein **bemerkenswerter Brückenbau** in Kiefersfelden. (2 000 Wörter & Abb.)

1955 **621** .133 .8
Der Eisenbahningenieur, Februar, S. 42.
RASCH (A.). — Verbesserungen an **Wasserstandsanzeigern für Dampfkessel.** (1 000 Wörter & Abb.)

1955 **625** .245 (43)
Der Eisenbahningenieur, Februar, S. 47.
WICHARD (W.). — Kostensparende **Ladeschwelle für Eisenbahnschienen-Wagen.** (800 Wörter & Abb.)

1955 **656** .212 .7 (43)
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Neue Umladeanlagen für den Stückgutverkehr. (1 000 Wörter & Abb.)

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1955 **625** .245 (43)
Eisenbahntechnische Rundschau, Januar, S. 1.
SCHRÖDER (E.). — Bauformen und Entwicklungsstand der **Bundesbahn-Kranwagen.** (4 300 Wörter & Abb.)

1955 **625** .232 (460)
Eisenbahntechnische Rundschau, Januar, S. 20.
HEUMANN (H.). — Zur **Problematik des Talgozuges.** (4 800 Wörter & Abb.)

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Eisenbahntechnische Rundschau, Januar, S. 29.
TACKE (F.). — **Lebensdauer und Bewährung der verschiedenen Schwellenarten** und damit zusammenhängende Unterhaltungsfragen. (2 400 Wörter.)

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1955 **625** .214 : **621** .335 (43)
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MUNDT (R.). — **Wälzlager in den neuen elektrischen Lokomotiven** der Deutschen Bundesbahn, Baureihe E.10. (4 600 Wörter & Abb.)

1955 **621** .33 (469)
Elektrische Bahnen, März, S. 62.
WITTGENSTEIN (M). — Die **Elektrisierung** der Portugiesischen Staatsbahnen. (700 Wörter & Abb.)

1955 **621** .335
Elektrische Bahnen, März, S. 65.
KÖHLER (H.). — Der **Anfahrwiderstand und sein Einfluss auf die Anhängelasten elektrischer Lokomotiven.** (1 400 Wörter & Abb.)

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SHERRINGTON (C.E.R.). — « **London Transport** ». The largest city transport undertaking in the world. (2 600 Wörter & Abb.)

1955 **385** .6 (4)
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ZILLER (H.). — Die **Europäische Güterzugfahrplankonferenz** (LIM), ein Organ der Europäischen Eisenbahnen im Dienste der Beschleunigung und Konzentration des Eisenbahngüterverkehrs. (2 800 Wörter & Abb.)

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SCHMIDT (O.). — Der **Personenwagenumbau** bei der Deutschen Bundesbahn. (7 900 Wörter & Abb.)

1955 **625** .62
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PETZOLD (W.). — **Statischer Belastungsversuch eines modernen Strassenbahn-Grossraum-Triebwagens in Stahlbauweise.** (1 700 Wörter & Abb.)

1955 **625** .213
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WEINERT (O.). — **Leitertafel zum Entwerfen von Drehstabfedern.** (700 Wörter & Abb.)

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Prof. Dr. BÄSELER. — **Fahrzeugführung** im Gleis international? (1 700 Wörter.)

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1955 **656** .2 (494)
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KRAPF (K) & AMSTUTZ (M.). — Die **Beziehungen zwischen Tourismus und Verkehr.** Eine grundsätzliche Betrachtung in Schweizerischer Sicht. (2 500 Wörter.)

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1955 **656** .23 (485)
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Dr. A. SJÖBERG. — **Wirtschaftsgebaren und Tarifpolitik** der Schwedischen Staatsbahnen. (10 000 Wörter & Tabellen.)

1955 **385** (436)
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Dr. M. SCHANTL. — Die **Kommerzialisierung** der Oesterreichischen Bundesbahn. (10 000 Wörter.)

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Signal und Draht, Februar, S. 21.
DELPY (A.). — **Das Mass der Abbremsung in Rampen- und Talbremse bei konstanter Zuführungsgeschwindigkeit.** (Ein neues Verfahren.) (6 600 Wörter, Tabellen & Abb.)

1955 **656** .212 .5
Signal und Draht, März, S. 37.
RÜFFLER (D.). — **Verteilung der Rangierzettel mit Blattschreibern.** (2 500 Wörter & Abb.)

1955 **656** .251
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GROSSKURTH (K) & PRÖBSTL (F.). — **Über ein praktisches Verfahren zur Darstellung der Lichtverteilung einer Signallaterne.** (1 000 Wörter & Abb.)

1955 **625** .258
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WEIDLICH (H.). — **Eine Hf-Geschwindigkeitsmessanlage zur Steuerung von Laufzielbremsen.** (1 100 Wörter & Abb.)

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1955 **656** .225
Verkehr, Nr. 15, 16 April, S. 465 und folgende.
Dr. M. SCHANTL. — **Transport-Verpackung.** Ein Rationalisierungsproblem für die Verkehrsträger und die verladende Wirtschaft. (1 000 Wörter.)

LEUENBERGER (P.). — Die **Standardpalettisierung** in der schweizerischen Wirtschaft und ihr Zusammenhang mit dem Ferntransport. (1 000 Wörter & Abb.)

Dr. W. UNVERZAGT. — Die **Palette als moderner Laderaum** im Stückgut- und Ladungsverkehr. (1 000 Wörter & Abb.)

HILLENIUS (C.). — **Transportverpackung und Verpackungsuntersuchung.** (700 Wörter & Abb.)

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GRELLIER. — Die Politik der S.N.C.F. und der öffentlichen Hand in Frankreich auf dem Gebiete der **Verpackung.** (1 000 Wörter & Abb.)

CALCAGNO (Dr. G.). — **Zerlegbare Behälter** als Transportmittel auf den Italienischen Staatsbahnen. (600 Wörter.)

PENTINGA (J.K.). — **Transportschutz.** (800 Wörter & Abb.)

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Verkehr, Nr. 16, 23. April, S. 509.
WALDBRUNNER (K.). — **Oesterreichische Bundesbahnen als selbständiger Wirtschaftskörper.** (1 300 Wörter.)

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1955 621 .438 (42)
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PICARD (F.L.). — **An experimental turbo-diesel locomotive.** (600 words & figs.)

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The Engineer, March 4, p. 321.
Diesel-electric locomotives for Sierra Leone. (900 words & fig.)

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The Engineer, March 11, p. 330.
Reports from the footplate. (2 900 words & figs.)

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Horizontal oil engine for railway traction. (900 words & figs.)

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The locomotive, March, p. 38.
3 600 H.P., 1 400 V.D.C. locomotives for India. (1 000 words & figs.)

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Progress in railway mechanical engineering - 1953/1954. (2 800 words, tables & figs.)

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TV checks car numbers. (1 100 words & figs.)

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CANTLIE (K.). — **The British locomotive industry.** (2 000 words & figs.)

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DU PLESSIS (D.H.C.). — **A full programme for South African railways.** (2 800 words & figs.)

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Modern Transport, March 12, p. 21.
Diesel-electrics in West Africa. (1 800 words & figs.)

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Modern Transport, March 12, p. 26.
Electric locomotives for India. (1 200 words, figs. & tables.)

1955 656 .23 (42)
Modern Transport, March 26, p. 3.
Railway charges scheme. (1 800 words.)

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Modern Transport, March 26, p. 13.
JOHNSON (A.C.). — **Electrification results.** (1 400 words.)

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205.6 M.P.H. - World's record railway speed. (1 900 words & figs.)

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South Tyneside electric. (1 400 words & figs.)

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L.M.R. resignalling. (900 words & figs.)

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New power plant for B.R. shunters. (1 600 words & figs.)

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The Oil Engine and Gas Turbine, Mid April, p. 456.
Gold Coast buys new loco fleet. (1 000 words & figs.)

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German railbus designs. (1 500 words & figs.)

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1955 656 .212 (73)
Railway Age, February 28, p. 22.
New Yard at Hamlet. (2 200 words & figs.)

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Railway Age, February 28, p. 27.
An advance in freight braking. (900 words & figs.)

1955 656 .257 (73)
Railway Age, March 7, p. 38.
How yard radio pays its way. (1 200 words & figs.)

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Railway Age, March 14, p. 59.
How reflection helps visibility. (2 000 words & figs.)

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1955 **656** .2 (42)
The Railway Gazette, January 28, p. 97.
Modernisation and re-equipment of British Railways. (7 000 words & tables.)

1955 **621** .132 .1 (6)
The Railway Gazette, January 28, p. 107.
Rhodesia Railways « 20 th » class locomotives. (2 500 words, figs. & tables.)

1955 **625** .162 (73)
The Railway Gazette, February 4, p. 130.
Whistle and radio control of level crossing gates. (1 200 words & tables.)

1955 **621** .338 (494)
The Railway Gazette, February 11, p. 158.
Torsion bar bogies on the Rhaetian Railway. (700 words & figs.)

1955 **656** .25 (432)
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New German colour-light signals. (700 words & figs.)

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A Railway Gazette Publication. (London.)

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Twin-disc hydraulic transmission. (1 800 words & figs.)

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Bureau reports on locomotive defects. (1 400 words, figs. & tables.)

1955 **621** .335 (73)
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New Haven gets rectifier locomotives. (2 100 words, figs. & tables.)

1955 **621** .431 .72 (73)
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Springfield Diesel shop. (1 100 words & figs.)

1955 **625** .214 (73)
Railway Locomotives and Cars, March, p. 91.
Standard journal box in for change. (2 300 words & figs.)

1955 **625** .174 (73)
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HOFFER (A.H.) & WILLHITE (R.E.). — **Electric drive for rotary snow plows.** (1 600 words & figs.)

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Modernisation and re-equipment of British Railways. (4 000 words & figs.)

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Train describers at Euston. (700 words & figs.)

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ALLEN (C.J.). — **British locomotives practice and performance.** (3 500 words, figs. & tables).

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When river floods up goes this railroad bridge. (1 200 words & figs.)

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BLANCHARD (L.C.). — Part III. — **The art of track raising — Tamping techniques.** (2 200 words & figs.)

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Cycle maintenance. (2 700 words.)

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Undercuts tracks in tunnels. (1 200 words & figs.)

In Spanish.

Ferrocarriles y Tranvias. (Madrid.)

1954 **656** .256 : **621** .33
Ferrocarriles y Tranvias, noviembre, p. 382.
GIBERT Y SALINAS (A.). — **Las conexiones inductivas de impedancia en los circuitos de via para señalización,** establecidos en las lineas electrificadas. (4 200 palabras & fig.)

1954 **385** (52)
Ferrocarriles y Tranvias, noviembre, p. 390.
CABRERA (J.B.). — Los **ferrocarriles nacionales** del Japón. (3 400 palabras.)

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Ferrocarriles y Tranvias, noviembre, p. 395.
El plan de modernización de los Ferrocarriles Británicos. (1 900 palabras.)

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SANCHEZ PEREZ (J.). — **Nuova sistema de tracción ferroviaria.** (1 500 palabras & fig.)

In Italian.

Giornale del Genio Civile. (Roma.)

1955 **624** .6
Giornale del Genio Civile, febbraio, p. 143.
DE ANGELIS (G.). — Studio sui **ponti ad arco incastrato a passagio superiore con travata collaborante coll'arco.** (2 100 parole & fig.)

Ingegneria Ferroviaria. (Roma.)

1955 625 .143 .3
Ingegneria Ferroviaria, febbraio, p. 93.
STAGNI (E.). — **Instabilità termica del binario per sollevamento e per inflessione laterale.** (4 500 parole & fig.)

1955 621 .332
Ingegneria Ferroviaria, febbraio, p. 100.
LO CIGNO (E.). — **Sul calcolo delle tensioni meccaniche nelle condutture elettriche.** (2 700 parole & fig.)

1955 656 .2
Ingegneria Ferroviaria, marzo, p. 159.
SAVOJA (A.). — Le **spese relative agli impianti fissi** nei diversi sistemi di trasporto terrestri. (3 200 parole & prospetti.)

1955 **34 : 656** (4)
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LANDRA (A.). — Evoluzione e progresso della **regolamentazione giuridica dei trasporti ferroviari** in Europa. (7 500 parole.)

1955 656 .23
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ZAQUINI (G.). — **Normalizzazione dei prezzi delle tariffe ferroviarie.** (1 800 parole & tabelle.)

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1955 625 .42 (45)
Politica dei Trasporti, marzo, p. 133.
MIOZZI (E.). — La **metropolitana** a Venezia. (2 800 parole & fig.)

1955 656 .1 & 656 .2
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Progressi nella **collaborazione strada-rotaia.** (1 200 parole & fig.)

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La Ricerca Scientifica, gennaio, p. 80.
LOCATELLI (P.), GRANDORI (G.) & MORAVIA (G.). — **Sull ricerca per via fotoelastica degli sforzi dovuti al peso proprio nelle strutture piane.** (3 000 parole & fig.)

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1955 **388**
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BRUSCHIERI (G.). — Sul **prodotto chilometrico nei trasporti urbani.** (1 300 parole & fig.)

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VOGT (H.). — Die **statische Behandlung schiefwinkliger Brücken.** (3 000 woorden & fig.)

Spoor- en Tramwegen. (Den Haag.)

1955 656 .212 .5
Spoor- en Tramwegen, nr 5, 3 Maart, p. 65.
DE COCK. — **De capaciteit van een rangeerheuvel** (1 400 woorden & fig.)

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Spoor- en Tramwegen, nr 5, 3 Maart, p. 67.
De spoorwegen voor een nieuwe periode van welvaart. Een beschouwing over vernieuwingen in het spoorwegbedrijf en wat de statistieken daarvan zeggen. (1 900 woorden.)

1955 625 .143 .5
Spoor- en Tramwegen, nr 5, 3 Maart, p. 76.
KRABBENDAM (G.). — **Nieuwe modellen van verende spoorstaafbevestiging.** (1 500 woorden & fig.)

1955 **385** (09 (438)
Spoor- en Tramwegen, nr 6, 17 Maart, p. 85.
De Statsspoorwegen in Polen. (3 700 woorden & fig.)

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Spoor- en Tramwegen, nr 6, 17 Maart, p. 89.
KRABBENDAM (G.). — **Houten dwarsliggers** bij de Britse Spoorwegen. (1 300 woorden.)

In Czec. (= 91.886.)

Inženýrské Stavby. (Praha.)

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Inženýrské Stavby, n° 4, 20 April, p. 134.
KRCHOV (J.) & ROSENBERG (Zd.). — **Prestressed concrete railway sleepers.** (1 000 words & figs.)

M. Weissenbruch & Co., Ltd., Printer to the King, 49, rue du Poinçon, Bruxelles.

M. WEISSENBRUCH & Co. Ltd.
Printer to the King

(Manag. Dir.: P. de Weissenbruch,
238, chaussée de Vleurgat, XL.)

PRINTED IN BELGIUM

Edit. responsible : P. Ghilain